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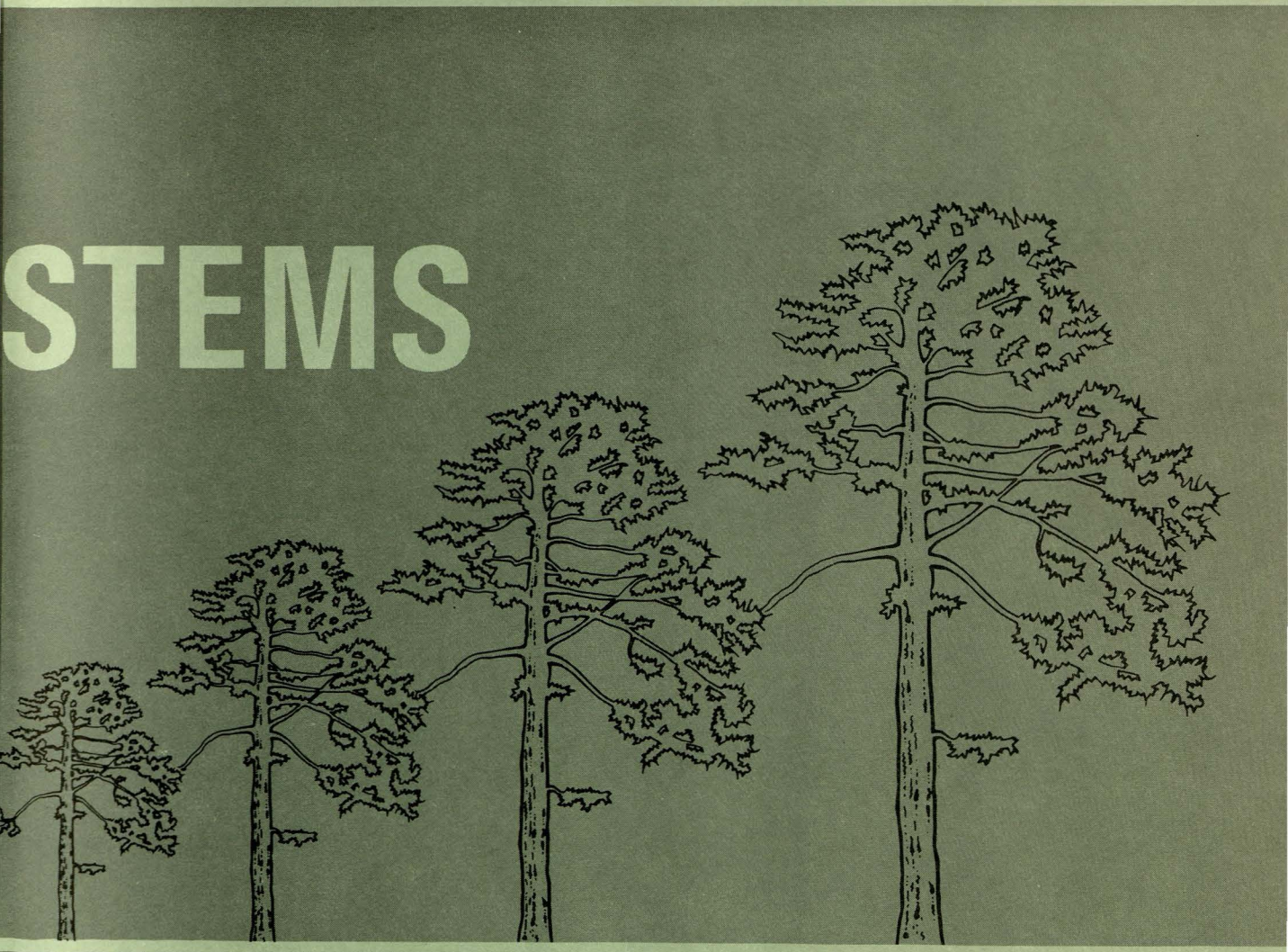
The User's Guide To STEMS

Stand and Tree Evaluation and Modeling System

David M. Belcher



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FOREWORD

In 1975, research was begun at the North Central Forest Experiment Station to develop a system that would update, project, and analyze forest resource information in the North Central Region. This comprehensive evaluation system, designed to analyze all forest resources and their uses as an integrated system, is known as FREP (Forest Resources Evaluation Program).

STEMS (Stand and Tree Evaluation and Modeling System) is the tree growth projection component of FREP. This component has also been known as TRES, FREP, and FREP78. Today's STEMS is the product of a team of researchers at the North Central Station; the development of STEMS continues.

This publication is one of three designed to acquaint you with different aspects of STEMS. A Description of STEMS, the User's Guide to STEMS, and A Programmer's Guide for STEMS make up the set.

CONTENTS

Page

SYSTEM ORGANIZATION 1

TGPS: THE TREE GROWTH PROCESSOR 1

Input 1
Run options 2
Volume and biomass coefficients 4
System parameters and specifications 5
Initial tree lists 6

Processing 6

Processing order 6
Subroutine GROW 8
Mortality 8
Management subsystem 8
Regeneration 9

Output 9

TABL: SUMMARY PROGRAM 10

Input 10
Processing 10
Output 12

LITERATURE CITED 16

APPENDIX I Sample read routine for TGPS 17
APPENDIX II Volume and biomass equations and coefficients 26
APPENDIX III TGPS System Parameters and Specifications 30
APPENDIX IV Example of Standard Output File 39
APPENDIX V Legend for Summary Tables 41
APPENDIX VI Procedure for accessing STEMS at the Fort Collins Computer Center (FCCC) 46

THE USER'S GUIDE TO STEMS (STAND AND TREE EVALUATION AND MODELING SYSTEM)

David M. Belcher, *Research Forester*

STEMS is a system of computer programs that projects the growth of individual trees in stands. It was developed at the North Central Forest Experiment Station as part of the Forest Resources Evaluation Program (FREP). Based on biological principles of forest growth, STEMS offers a flexible, generalized approach to simulating the change of forest trees in stands. Coefficients for its generalized diameter growth and mortality functions have been developed from more than 2,500 permanent remeasured plots for all the major tree species in the Lake States—Minnesota, Wisconsin, and Michigan. STEMS is an individual tree, distance independent model that can provide much detail about trees and stands. Because each tree is projected individually, the system offers users the opportunity to tailor output and silvicultural treatment subroutines to meet their specific objectives. User control of management options and types of summaries further serves to make STEMS suitable to a variety of user needs. Changes for a single stand may be monitored in great detail and whole forest inventories may be projected. Information about FREP and earlier versions of the tree growth projection system have been previously published by Buchman (1978), Lundgren (1978), Lundgren and Essex (1978), USDA Forest Service (1979), Hahn *et al.* (1979), and Smith and Raile (1979).

This User's Guide does not require an extensive knowledge of programming. However, a basic familiarity with some of the terminology used in data processing will be beneficial. First the organization of the STEMS system is presented. Then the required input, the processing that is done, and the output that is produced are discussed in detail for each part of the system.

SYSTEM ORGANIZATION

STEMS consists of two separate programs—TGPS and TABL (fig. 1). The TGPS (Tree Growth Processor) program is the main part of STEMS. TGPS "grows" stands of forest trees by estimating the growth of individual trees with a series of projection equations. These projection equations predict annual diameter growth of the tree, probability of mortality, and crown ratio. Stand characteristics may be computed from the updated individual tree characteristics. A Standard Output File of initial and updated tree lists is produced for later summarization by TABL or other programs.

The TABL program is provided to summarize the Standard Output File by species group and user-specified diameter classes. Summaries are produced for each plot and for all plots at the end of each growth or management cycle and at the end of the projection. Details of the tables are presented under the OUTPUT heading in the TABL section of this paper.

STEMS does not contain a standard read routine for the initial tree lists because it is unlikely that any two users will have their data in the same form. Therefore the user must write his own read routine. A sample read routine with an associated initial tree list is presented in Appendix I.

TGPS: THE TREE GROWTH PROCESSOR

Input

Input to TGPS consists of four separate parts: run options, optional volume coefficients, system param-

eters and specifications, and initial tree lists to be projected. Individual subroutines are available for input of each part.

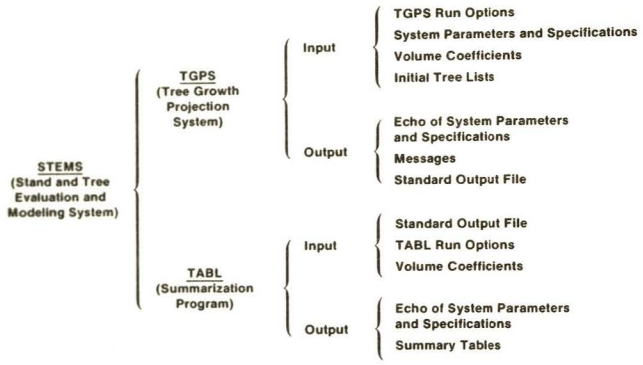

Figure 1.—*Organization of STEMS.*

Run options

Run options determine the characteristics of the projection by setting values such as the length of the projection, management option to be applied, and types of output to be produced from TGPS. Subroutine SETRUN is used to enter this information. To make this input as simple as possible, a keyword type process is employed. Each available option has a keyword and associated value. The keywords can appear in any order within the run option file. Each keyword has a default value so that only a minimum number of entries is required. These options will be modified frequently as the user chooses different ways to run STEMS.

The keywords must be in the first four columns of each record and columns 5-19 may be used to expand the keyword into a more readable form. Each keyword that requires a value must have that value in columns 20-29 and must have a decimal point included.

These are the options used to produce the example presented later in this guide.

```
TITLE
"STEMS": SAMPLE RUN FOR RELEASE VERSION OF THE TREE GROWTH PROJECTION SYSTEM.
CYCLES                  3.   NUMBER OF GROWTH CYCLES.
YEARS IN CYCLE          10.  YEARS *CYCLES = 30 YEAR PROJECTION.
PLOTS TO PROCESS        0.   NUMBER OF PLOTS. 0 MEANS ALL PLOTS WILL BE USED.
MORTALITY               1.   0=DETERMINISTIC, 1=PROBABILISTIC.
MANAGEMENT              2.   2=MID-POINT OF EACH CYCLE.
REGENERATION            1.   1=USED AS NEEDED, 0=NOT USED.
UNITS FOR VOLUME        0.   0=NO VOLUMES, 1=BIOMASS, 2=CU.FT., 3=BD.FT, ...
STANDARD OUTPUT         1.   1=WRITTEN AS CODED FILE,3=BINARY.
FREQUENCY OF OUTPUT     1.   1=TREE LISTS WRITTEN BY CYCLE, 0=YEARLY.
USER OUTPUT             0.   0=NONE, 4=BY CYCLE.
MESSAGES                4.   INFORMATIVE MESSAGE CODE.
ECHO OF PARAMETERS      1.   1 MEANS SYSTEM PARAMETERS WILL BE PRINTED.
DEBUG                   0.   DEBUG SUBROUTINE WILL NOT BE USED.
SEED                    31.  RANDOM NUMBER SEED.
```

The following keywords are available in TGPS:

KEYBOARD	DEFINITION	DEFAULT
TITL	User specified run title should appear on the record following this keyword and should be typed within the first 80 columns.	All blanks
RUN	Run identification should appear on the record following this keyword and should be typed within the first 16 columns. Used only when standard output summaries will be used.	All blanks
TYPE	Run type: 1 = validation; 2 = projection. (Validation is not discussed in this Guide)	2.
CYCL	Number of growth or management cycles.	0.
YEAR	Number of years in each cycle.	0.
PLOT	Number of plots to be processed. 0 = process all plots on the TAPE11 input file.	1.
MANA	Management: 0 = no management; 1 = management routines called on first year of each cycle; 2 = mid-point management; 3 = last year management; 4 = user will specify management years with keyword CUT.	0.
CUT	User specified years for calling management routines should appear on the record following this keyword and should start in column 1 with one space between each year. Maximum number of years is 10 and decimal points must not be used. This keyword must be specified if MANA = 4.	All zero's
REGE	Regeneration: 0 = regeneration routines will not be used; 1 = regeneration routines will be called as needed.	0.
MORT	0 = deterministic; 1 = probabilistic.	1.
UNIT	0 = no volumes of any kind will be computed; 1 = biomass in cubic feet; 2 = cubic feet; 3 = board feet; 4 = cubic feet in saw logs; 5 = cords (79 cubic feet/cord).	0.
MESS	Informative messages: 0 = No messages; 1 = TESTIT block only; 2 = TESTIT and short tree list information; 3 = TESTIT and short management summary; 4 = 2 + 3; 5 = 4 + notes at entry and exit of major subroutines; 6 = 5 + extra notes.	0.

STAN	Standard output: 0 = no Standard Output File will be produced; 1 = both the projected tree lists and system parameter files will be written in coded format; 2 = tree lists (coded), no parameter file; 3 = tree lists (binary), parameter file (coded); 4 = tree lists (binary), no parameter file. Note that use of program TABL requires a parameter file to be produced by TGPS.	1.
FREQ	Frequency of standard output: 0 = tree lists written to Standard Output File yearly; 1 = tree lists written at end of each cycle.	1.
USER	User output: Selects time of call to user written Subroutine OUTUR. 0 = no calls will be made to Subroutine OUTUR; 1 = OUTUR called before any projection is done; 2 = OUTUR called for each plot after the initial tree list is read but before the plot begins projection. Initial conditions will be printed at this point; 3 = OUTUR called at the end of each year of projection for each plot; (**Caution:** this may produce a lot of output). 4 = OUTUR called at the end of each cycle for a plot; 5 = OUTUR called at the end of all cycles for a plot; 7 = OUTUR called at the end of all cycles for all plots. (Final summary).	0.
ECHO	Echo check: 1 = list of system parameters and equation coefficients; 0 = no list.	0.
DEBU	Selects time of call to diagnostic Subroutine DEBUG. The codes are the same as for Subroutine OUTUR.	0.
READ	Read routine: 1 = SILV-EXAM read routine; 2 = User's Guide example; 3 = National Forest; 4 = User's own routine.	31.
WAIT	Minimum number of years to wait between thinning and clearcut for all management guides.	0.

Volume and biomass coefficients

Tree volumes are not a formal part of the TGPS program. However, users who wish to do their own output through use of Subroutine OUTUR may also wish to have the capability to compute volumes. Coefficients for the standard volume equations included in TGPS are entered with Subroutine SETVOL.

Volume and biomass equations provided in STEMS produce estimates of tree volume in a variety of units. One unit is chosen for all volume computations for a run with the keyword UNIT. Note that UNIT can be specified as 0 for runs in which no volume computations are desired. Volume information can be developed for each of the available units through repeated runs of the programs.

This version of STEMS contains two sets of volume equations—one was developed for northeastern Minnesota (Raile 1980) and the other was developed for Wisconsin (Hahn 1973). The user chooses an equation by using the appropriate volume coefficient file. Each file has a State code identifier that indicates the correct equation form to be used. The equations were provided by the North Central Forest Experiment Station Renewable Resources Evaluation Project.[1]

[1]*Personal communication with W. B. Smith and Gerhard Raile of North Central Forest Experiment Station, October 1979.*

Appendix II contains a list of the volume and biomass coefficients supplied with STEMS. See the Programmer's Guide (In preparation) for details on replacing these volume equations with your own.

System parameters and specifications

The System Parameter file contains the coefficients for the projection equations, species group assignments, critical values for management guides and regeneration, and other values necessary for operating TGPS. Subroutine SETSYS is used to read these values. This file is read before projection of the first plot begins. Appendix III contains a complete list of the system parameters and specifications.

The first section of this file sets the conversions from user species codes to FREP species groups. The species codes used are the standard codes given in the USDA Forest Service Handbook. These codes appear in the first column of numbers. The second column holds the FREP species group number to which the user species will be assigned. The next column holds names of the user species and is not used by STEMS but may be used for descriptive purposes within the file. The last column holds up to 12 letters for the name of the FREP species group. For example: species number 746 is assigned to FREP species group 25 and given the name QUAK.ASPEN (quaking aspen). Species with similar characteristics or insufficient data may be combined within a group. For example, all the elms are combined into species group 15 and assigned the name ELM. Users who wish to alter the species group assignments should do so carefully because the projection equation coefficients are all calibrated by species group, not by species.

The second section of the system parameter file contains the crown ratio function coefficients followed by a section holding the cover type names and management guide assignments. The first column of numbers is the cover type code and is referred to as KTYPE. The second column is the code for the management guide that will be associated with this cover type. For a thorough discussion see Brand (1979, 1981).

Critical values for the management guides are presented next. Alternative management strategies can be examined by altering these critical values. Each guide has a variety of values, each with its own meaning. These values are also discussed in Brand (1979, 1981).

The following two sections in the system parameter file hold coefficients for the mortality and potential growth equations. The first line in each section assigns equations to species groups with the first number in the assignment line being the number of equations available. Each of the subsequent positions in this line holds the equation number assigned to the species group in the corresponding position. For example, equation 2 in the mortality section (red pine) is assigned to species group 10 (other softwoods) because the number 2 appears in the 10th position in the assignment line. A discussion of the mortality and potential functions is presented in USDA Forest Service (1979).

The modifier function coefficients appear next.[2] Changes in these coefficients, as for the mortality and potential coefficients, require refitting the models and should not be done without a thorough statistical examination. However, the coefficient in the second column in exponential notation is an exception. It is maximum basal area expected for a species group and can be changed by approximately 50 square feet to more closely approximate the user's situation without refitting the model.

The next section presents decision values for the marking rules used in the management guides. The values set cutting diameter limits, order of cut by tree species and tree class, etc. See Brand (1979, 1981) for a discussion of the marking rules and suggestions for modification of these values.

Species site index conversion coefficients are presented next (Carmean and Vasilevsky 1971, and Carmean 1979). Each entry consists of four items: the predictor species group number, the predicted species group number, and the intercept and slope coefficients for the simple linear regression. For example, if plot site index is measured on jack pine (species group 1), site index for red pine (species group 2) on that plot is computed as SIrp = 19.38 + 0.64 (SIjp).

Critical values for regeneration consist of one or more lines for each "block". A block is a description of the new stand that occurs at the end of a branch in the regeneration decision trees (see the regeneration section of this Guide for a discussion of the decision trees). The information presented for a block is:

Column	Description
1-2	Cover type identification.
3-4	Management guide used to remove previous stand.
5-6	Block number within management guide.

[2]*The modifer function and coefficients used here were developed by M. R. Holdaway, North Central Forest Experiment Station.*

8	Type of origin for new stand: 1 = natural; 2 = plant.
10	Site preparation code: 0 = site preparation assumed not done; 1 = assumed done.
12	Release code: 0 = assumed not done; 1 = assumed done.
13-14	Number of species groups on new plot.
15-17	Species group number for new trees
18-22	Number of trees/acre for this species group.
23-26	Arithmetic average diameter for this species group.
27-31	Standard deviation about the average diameter.

Species group number, number of trees/acre, average diameter, and standard deviation are repeated for each species group present in the new stand using the same format as used in columns 15-31.

The final section holds coefficients for computing individual tree height. The height equations are currently being developed by Dr. Alan R. Ek of the University of Minnesota, College of Forestry. Until the development of these equations is complete, space is reserved for the coefficients and is filled with zeros.

Initial tree lists

Initial tree lists for projection must be prepared by the user and read by the user-written Subroutine READ. Each tree list represents a stand of trees that may be actual measurements or hypothetical data. The tree list file can consist of any number of tree lists. Minimal data required for each tree are species code, diameter, and tree expansion factor to a per acre basis. Observed crown ratio is needed but an equation is available to predict crown ratio if it is not known. Minimal data required for each tree list are site index and size in acres represented by the tree list. See the sample READ routine in Appendix I for further notes about the initial tree lists.

Processing

Processing order

In TGPS, the input subroutines SETRUN, SETVOL, and SETSYS are called first in that order to read the run options, volume coefficients, and system parameters and specifications (fig. 2). The remaining subroutines compose the Plot Processor Loop. This Loop is executed once for each tree list on the tree list input file or for a lesser number of tree lists if keyword PLOT is used.

The first action of the Plot Processor Loop is to read an initial tree list with Subroutine READ. When tree list input is complete, Subroutine TESTIT is called to examine the tree list. TESTIT checks data that are or may be entered with READ and searches for conditions likely to produce undesirable results later in the program. Informative messages are printed to describe any problems and any corrective measures that have been taken. The detail of these informative messages is controlled with keyword MESS.

Subroutine SETSI computes site index by species group based on the work by Carmean and Vasilevsky (1971) and Carmean (1979). If the species on which the plot site index was measured is not set by the READ routine, the species group with the most basal area on the plot is assumed to be the predictor species group. Site index for each of the remaining species groups is predicted by Carmean's equations. Site index for any species group for which there is no information defaults to the site index for the plot.

The next subroutine in the Plot Processor Loop is COVTYP. It sets the cover type for the plot by examining the current basal areas of the species groups present. This first call to COVTYP computes the cover type for the initial tree list.

Next Subroutine WRITER is called. This subroutine writes three types of information to the Standard Output File (discussed in a later section). The first type is plot specific information and does not change over the projection period. The second type is the current tree list, and the last type is a trailer record that indicates all output for this plot is complete. At this point within the Plot Processor Loop, only the plot specific information is written.

Subroutine WRITER is called again to write the initial tree list and stand conditions to the Standard Output File. Note that no projection has been done yet. The initial tree list written here is the same one entered with READ and is included in the output file for summarization purposes.

At this point TGPS enters the Growth and Management Loop. This Loop is executed once for each of the cycles requested by keyword CYCL. The main feature of this loop is a call to Subroutine GROW, which "grows" the plot for one cycle by applying a sequence of 1 year projections. If management is desired, it is performed at the requested point within the cycle by calls to Subroutine MANAGE. The projected tree list is written to the Standard Output File by Subroutine WRITER from within GROW.

When the Growth and Management Loop has completed all of its cycles, the projection of the current plot is complete. WRITER is called again to write a trailer record on the Standard Output File to indicate

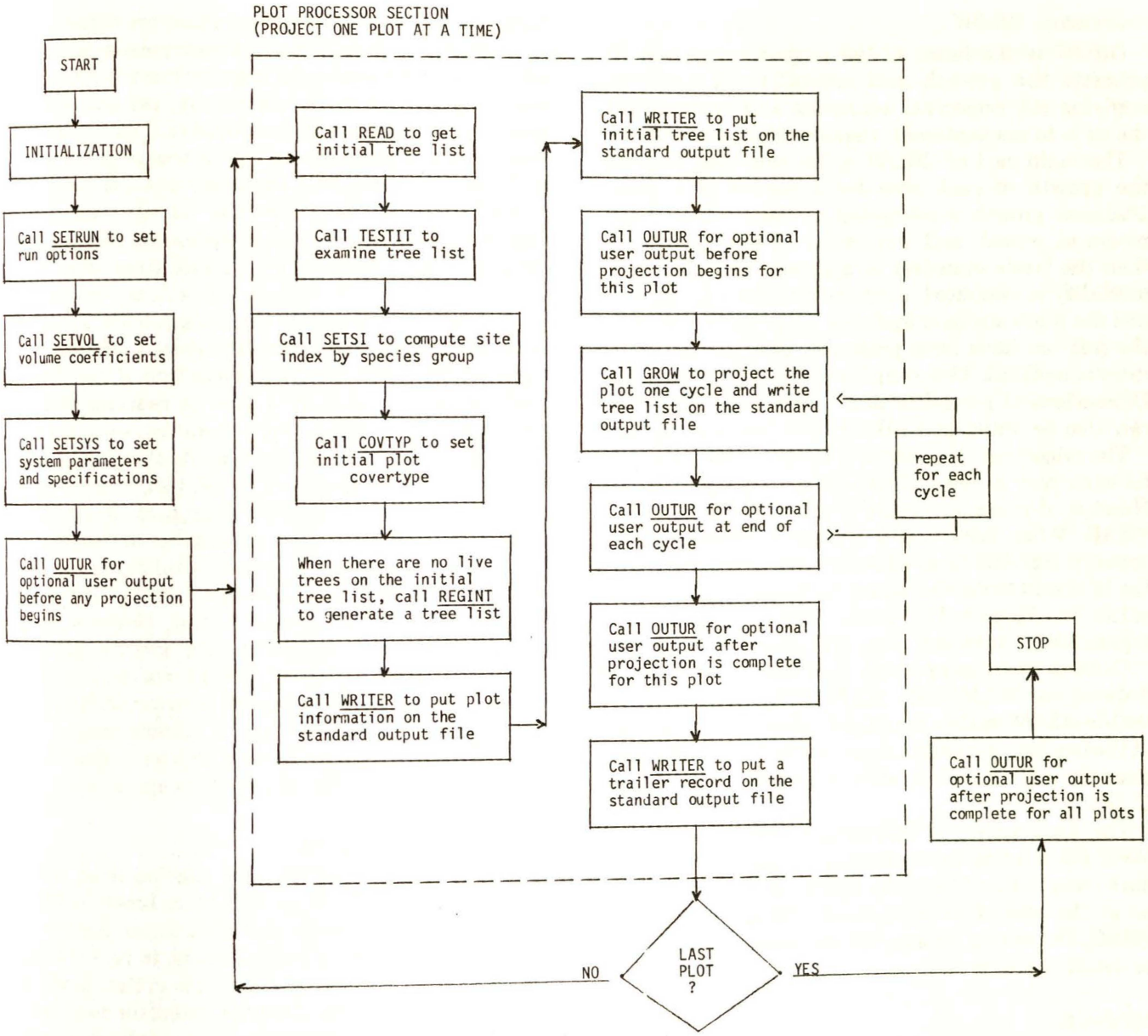
PLOT PROCESSOR SECTION
(PROJECT ONE PLOT AT A TIME)
START
INITIALIZATION
Call SETRUN to set run options
Call SETVOL to set volume coefficients
Call SETSYS to set system parameters and specifications
Call OUTUR for optional user output before any projection begins
Call READ to get initial tree list
Call TESTIT to examine tree list
Call SETSI to compute site index by species group
Call COVTYP to set initial plot covertype
When there are no live trees on the initial tree list, call REGINT to generate a tree list
Call WRITER to put plot information on the standard output file
Call WRITER to put initial tree list on the standard output file
Call OUTUR for optional user output before projection begins for this plot
Call GROW to project the plot one cycle and write tree list on the standard output file
repeat for each cycle
Call OUTUR for optional user output at end of each cycle
Call OUTUR for optional user output after projection is complete for this plot
Call WRITER to put a trailer record on the standard output file
LAST PLOT ?
NO
YES
Call OUTUR for optional user output after projection is complete for all plots
STOP

Figure 2.—*Organization of TGPS, the tree growth processor.*

the end of all tree lists for this plot. This also signals the end of the Plot Processor Loop and control returns to READ to enter the next plot to be projected.

When all the plots to be projected are complete, a final call to WRITER is made to print the format used for the Standard Output File. This is the format to be used if the user desires to summarize the Standard Output File tree lists with his own summarization program.

At several places within the program, TGPS provides calls to Subroutine OUTUR. This subroutine consists only of the common block and RETURN statement. It is intended to be a hook for insertion of user written code to do any further processing the user desires (such as summarization, output, etc.). Keyword USER sets the timing of calls to Subroutine OUTUR.

Subroutine GROW

GROW is the heart of the projection system. It projects the growth and mortality of trees by applying the projection equations and it organizes the calls to management, regeneration, and output.

The main part of GROW is the loop that projects the growth of each tree for a period of 1 year. Diameter growth is computed as the product of the potential growth and a modifier of that potential, then the tree's diameter is updated. Probability of mortality is computed, a mortality option is applied, and the tree's status is updated. After all the trees in the tree list have been projected, each tree's crown ratio is updated. This completes the projection loop. Discussions of mortality and crown ratio functions can also be found in USDA Forest Service (1979).

The projection loop within GROW is executed once for each year in the growth and management cycle. Number of years in a cycle is set with the keyword YEAR. When each year's growth is complete, Subroutine REGEN is called to add new trees to the tree list to simulate regeneration. In the current version of the Tree Growth Projection System, all aspects of regeneration have not been addressed.

Calls to the management routines are done with Subroutine MANAGE. MANAGE is called from within GROW so that management can be performed at the beginning, midpoint, or end of a cycle or at any year the user specifies with keywords MANA and CUT.

The final action of Subroutine GROW is to call WRITER to write the updated tree lists to the Standard Output File. Tree lists may be written annually or at the end of each cycle according to keyword FREQ. The option chosen will depend on the amount of detail the user desires.

Mortality

STEMS provides two options for assigning mortality to individual trees. The options are known as probabilistic and deterministic mortality and are selected by the keyword MORT. For each option, the probability of death for a tree during the coming year is computed as a function of diameter growth rate and current diameter. See USDA Forest Service (1979) for discussion of the mortality function. The difference in the two options is the way the mortality factor is applied. For probabilistic mortality, a random number between 0 and 1 is drawn and if the probability of death is greater than this random number the tree is marked as dead. Note that when a tree on the tree list dies, all the trees per acre represented by that tree also die and the tree is nullified in the tree list. For deterministic mortality, the tree's expansion factor is reduced by the proportion predicted by the mortality function. Thus, deterministic mortality can be thought of as reducing the number of trees per acre represented by a tree on the tree list. When a tree's expansion factor is reduced to 1, mortality type reverts to probabilistic so that a tree on the tree list will not represent less than one tree per acre.

Each type of mortality has its advantages and disadvantages and it is up to the user to decide which option is appropriate to his situation. For large numbers of plots and short projections, the two options produce essentially the same results. Probabilistic mortality is more computationally efficient than deterministic but for long projections it can lead to undesirable results, if a plot is reduced through mortality or cutting to two or three entries on the tree list, each tree on the list represents about one-half or one-third of the basal area on the plot. If one of these trees dies, the plot loses a large proportion of its basal area at once. This is not a reasonable representation of natural mortality. The deterministic option does not have this problem because it retains the tree list entries for a much longer period. However, more computations are necessary and annual output of tree lists is required when summary of components of growth is desired. For large numbers of plots the size of the standard output file can become critical. The probabilistic option produces a shorter output file for the same components of growth summaries.

Management subsystem

Management routines are applied from within Subroutine GROW by a call to Subroutine MANAGE. Keywords MANA and CUT allow user specification of the time of management to be: (1) before projection begins for the current cycle, (2) at the midpoint of the cycle, (3) at the end of the cycle, or (4) at any specified year or years regardless of cycle. Calls to the three management routines COVTYP, SCREEN, and TREAT are all placed within MANAGE to facilitate user modification or replacement of the subsystem.

COVTYP is caled first to determine the current cover type of the plot. It examines the basal area of each species group and assigns a cover type code based on the combination of species groups that has the most basal area. SCREEN selects the management guide and maring rule to be used based on the plot cover type and other stand variables such as age and site index. TREAT then performs the management by applying the marking rule selected by SCREEN. Trees designated as cut have their status code changed and are excluded from any further live tree computations.

A full discussion of COVTYP, SCREEN, and TREAT can be found in Brand (1981). This paper also describes the data required for the routines and discusses modifications that can be made to alter the guides.

Regeneration

Regeneration is simulated by placing new trees in the tree list. New trees can enter the tree list at three times. The first is after a clearcut when the whole tree list is to be renewed. Another is after a thinning or shelterwood cut when a portion of the tree list is to be renewed. Finally, a few trees should enter the tree list each year to simulate the natural occurrence of new seedlings. STEMS provides regeneration only for a full tree list after a clearcut. The other two types, partial regeneration and a "dribble function", are not included in STEMS at this time but are planned for future versions. Regeneration in the current version of STEMS consists of renewing the full tree list after a stand is removed by clearcutting or equivalent management action. Two subroutines, REGEN and TRLIST, are used for this process. REGEN works through a "logic tree"[3] that examines the characteristics of the previous stand and selects characteristics for the new stand. Previous stand characteristics examined are cover type, management applied, plot and species group basal areas, site index, and hydrologic regime. A block of characteristics for the new stand is selected and includes information such as the species groups present, number of trees, and average diameter for each species group.

After the new stand characteristics are determined, TRLIST is called to generate diameter distributions for the species groups on the plot. This subroutine assumes a normal distribution of diameters about an average diameter for each species group. The normal distribution is probably not the best one for modeling a regenerated stand so work is currently under way to determine a more realistic method for generating the new trees.

The management routines can result in two actions other than clearcut that trigger a full regeneration. The first is a shelterwood removal in which the overstory is removed several years after a shelterwood cut. This is essentially the same as a clearcut because there is currently no provision in STEMS to simulate the new growth that occurs after a shelterwood cut. The second action is strip clearcut in which a third of the stand is clearcut. Because STEMS cannot clearcut partial stands, every third stand designated as strip clearcut is completely clearcut and the others are unaltered. Over a large area the results are the same as if a third of each stand were clearcut.

[3] *The logic trees used in REGEN were developed by Nancy Walters and Gary Brand at NCFES. Diagrams of the logic trees are available upon request.*

Output

Previous versions of STEMS have included basic summarization routines within the program to perform the projections. To simplify operations and allow for easier insertion of new modules in the future, all summarization output routines have been placed in a separate program, TABL. Communication between the projection program, TGPS, and the summarization program, TABL, is done by use of a Standard Output File written by TGPS.

The Standard Output File consists of the initial and all updated tree lists for every plot in the run. These tree lists, along with an auxilliary file of system specifications, equation coefficients, and species group names, are available for input to the program TABL. These files were designed for two purposes. The first was to provide a convenient form of input for TABL. However, many users will not need the detail provided by TABL and will prefer to write their own summary routines. Therefore, a second purpose was to provide tree lists written in a simple form that would be easy to read with any FORTRAN program. This user-provided FORTRAN program could perform summaries itself or could reformat the data so it would be suitable for any of the standard statistical packages such as SPSS, BMD, SAS, or others. The tree list file and the system specification file must be saved using the procedures at your computer center so that the files can be available for later use with TABL or other programs.

The format of the Standard Output File is presented in detail in the Programmer's Guide (In preparation). An example is shown in Appendix IV.

For users with summarization goals not complex enough to require a separate summarization program, another option exists in TGPS. Subroutine OUTUR, a dummy subroutine, is provided as a hook for insertion of a user-written subroutine. Calls to OUTUR are provided at logical points within TGPS, such as at the end of each cycle for a plot or at the end of all cycles for a plot. Although OUTUR is intended for user summarization, it is not restricted to this purpose. It may be used for further processing, other user output, calls to other subroutines, or any other purpose the user desires.

TABL: SUMMARY PROGRAMS

Program TABL is a separate program provided as part of the STEMS package to produce summary tables from the Standard Output File written by TGPS. Detailed tables can be presented for each plot and for all plots in the run.

Input

Input to Program TABL consists of four separate files. First is the file of run options that provides information such as types of tables to be produced, print detail, and diameter classes to be used in the tables. The options are read as fixed format type (not keyword). The options must appear in this order and there are no defaults. Columns not used by the specified formats may be used for comments to explain the values being used. The options are:

CARD NUMBER	DEFINITION	FORMAT
1	Title: Title for these tables will be printed under the title used in TGPS.	20A4
2	ID: Run identification. Must match ID used in TGPS.	4A4
3	Echo Check: 1 = echo of system parameters used in TGPS; 0 = no echo.	I1
4	Table Type: 0 = no tables; 1 = periodic plot tables (one/cycle); 2 = projection plot tables (one/plot); 3 = run and cover type tables; 4 = 1 + 2; 5 = 2 + 3; 6 = 1 + 3; 7 = 1 + 2 + 3.	I1
5	Print Detail: 0 = species totals only (no diameter lines); 1 = species totals and diameter lines (full table); 2 = grand total only (with diameter lines).	I1
6	Diameter class limits—set by user for output classification. The lowest class is bounded below by zero. The highest class is open above. The number of classes available is set by parameter MAXD and is equal to MAXD + 1.	10F5.1
7	Diagnostic subroutine DEBUG. Code for calls to DEBUG is the same as for calls to OUTUR.	I1
8	Number of plots to process. 0 = All plots in Standard Output File.	I5
9	Units for volumes: 0 = no volume computations; 1 = biomass in cubic feet; 2 = cubic feet; 3 = board feet; 4 = cubic feet in saw logs; 5 = cords (79 cubic feet/cord).	I1
10	Standard output code: 1 = tree list input file is coded; 3 = tree list input file is binary.	I1
11	Ingrowth diameter limit for number of trees and basal area portion of table.	F4.1
12	Ingrowth diameter limit for volumes portion of table.	F4.1

The TABL run options file that produced the summary outputs shown in figure 3 is:

```
"STEMS":TABL      STANDARD OUTPUT SUMMARY PROGRAM.
                  RUN ID. SHOULD MATCH ID FROM TGPS.
1         ECHO OF SYSTEM PARAMETERS USED IN TGPS.
7         TABLE TYPE
1         PRINT DETAIL
  5.0 11.0        DIAMETER CLASS LIMITS
0         DEBUG
0         NUMBER OF PLOTS TO PROCESS. 0 MEANS ALL.
2         UNITS FOR VOLUMES
1         STD. OUTPUT FILE CODE
 5.0      DBHINT. INGROWTH LIMITS.
 5.0      DBHINV. INGROWTH LIMITS.
```

The second TABL input file is the system parameter and specification file produced by TGPS as part of the Standard Output File. The third input file holds the updated tree lists from TGPS and is also part of the Standard Output File. The last TABL input file is the same file of biomass and volume coefficients used by TGPS.

Processing

Execution of TABL begins with a call to Subroutine SETUP to read the run options, volume coefficients and system specifications (fig. 3). Then the Plot Processor Loop is entered. First the header information for a plot is read, then a loop reads each tree list and calls the summary and table subroutines. The Plot Processor Loop is done once for each plot on the input file. After all the individual plots have been read, summarized, and tabled, run summary tables are presented both in the form of the individual plot tables and as cover type tables. The last action of Program TABL is to print a legend explaining the meaning of each of the column headings.

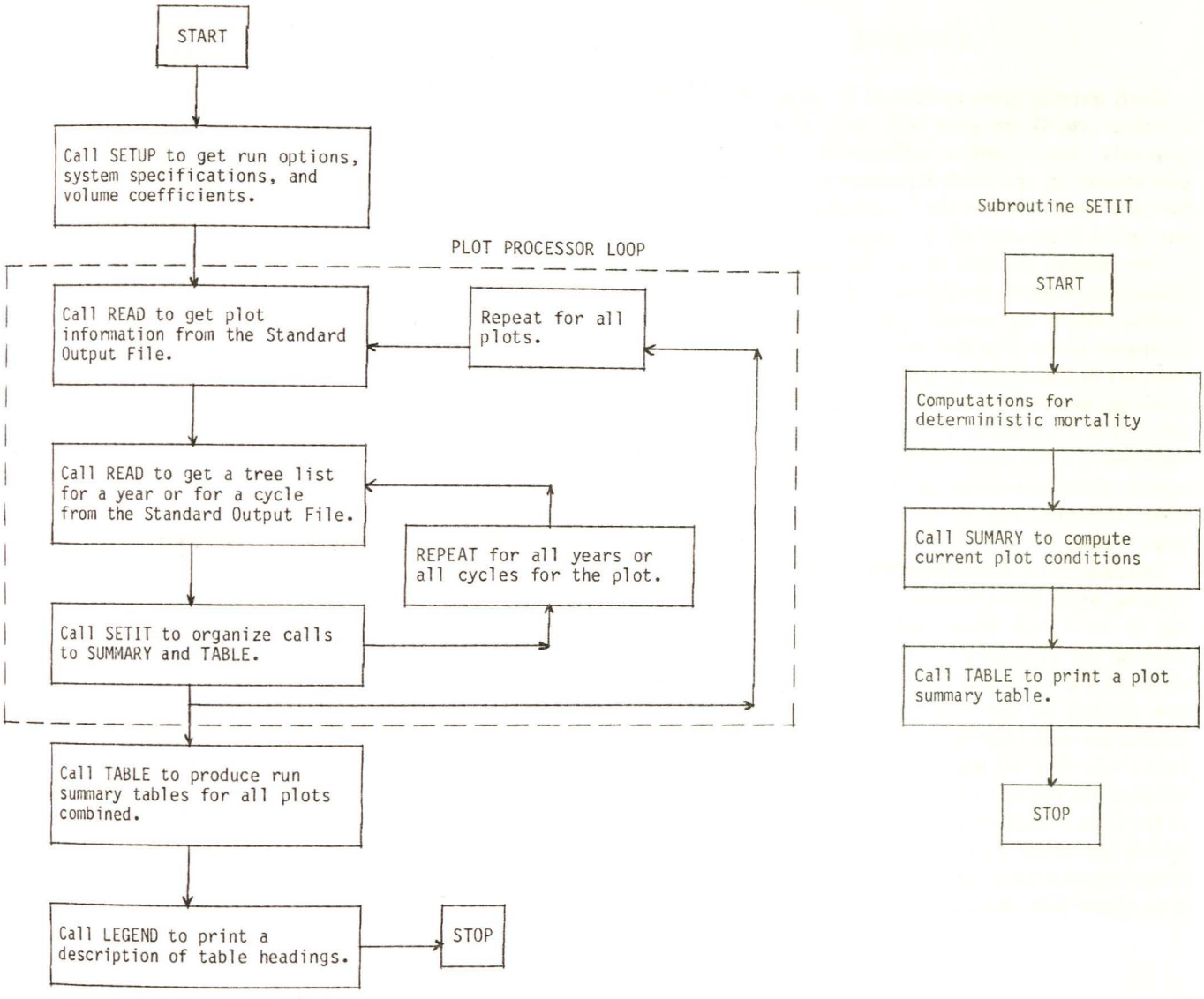
START
Call SETUP to get run options, system specifications, and volume coefficients.
PLOT PROCESSOR LOOP
Call READ to get plot information from the Standard Output File.
Repeat for all plots.
Call READ to get a tree list for a year or for a cycle from the Standard Output File.
REPEAT for all years or all cycles for the plot.
Call SETIT to organize calls to SUMMARY and TABLE.
Call TABLE to produce run summary tables for all plots combined.
Call LEGEND to print a description of table headings.
STOP
Subroutine SETIT
START
Computations for deterministic mortality
Call SUMARY to compute current plot conditions
Call TABLE to print a plot summary table.
STOP

Figure 3.—*Organization of TABL, the standard summary routine.*

Subroutine SETIT organizes the calls to the summary and table subroutines. Its first action is to compute values used in deterministic mortality summarization if that mortality option was selected in TGPS. Then Subroutine SUMARY is called to summarize current plot conditions and compute the components of growth for the plot. Subroutine TABL is then called to print the summary table. After the last plot has been summarized and tabled, tables are produced to summarize all plots together for each cycle and for all cycles.

SUMARY is the heart of the TABL program. It examines each tree in the current tree list. The number of trees per acre, basal area per acre, and volume per acre represented by each tree is assigned to the appropriate cell of the summary array by species group and by user set diameter class. This is the point at which live, dead, cut, and ingrowth trees are segregated into the appropriate categories. After each tree has been examined and summed, totals are computed by species group and by diameter class.

When summarization is complete, SETIT computes some of the values used in the table heading. Then TABL is called to print the table for the current condition of the plot. After tables for each cycle for the plot are printed, TABL is called again to print a summary of all cycles for the plot.

Output

Each output table produced by program TABL is divided into 3 sections (fig. 4a). The first section presents identification information about the plot, plot statistics, and control parameters. The definition for each term used in the heading and in the body of the table is presented in Appendix V.

The second section of the output table presents information about the number of trees and basal area broken down by species group and user-specified diameter class. For the example shown in figure 4, the plot contained two species groups: jack pine and quaking aspen. The arbitrary diameter classes were set at 0-5, 5-11, 11 + inches. The columns for initial number of trees/acre and initial basal area/acre represent stand conditions in the initial year (1980). All other columns represent conditions at the current year (1990).

Discussion of the body of this table is best done by tracing some trees through the table. For jack pine, the 0- to 5-inch class begins with 260 trees/acre. During the 10-year period represented by this table 60 trees did not cross the ingrowth limit. These trees are shown in the NON-ING column (NON-ING stands for non-ingrowth). Of the initial 260 trees in this class 40 died and appear in the MORTALITY column. At the end of the period 60 live trees remain in the 0- to 5-inch class. But 260 initial trees minus 40 mortality trees minus 60 current trees leaves 160 trees unaccounted for in the 0- to 5-inch class. These trees grew past the user-set ingrowth diameter limit (5 inches) and are shown in the INGROWTH column in the diameter class they occupied at the end of the period (5-11 inches). Note carefully the definition of ingrowth (a tree that crosses the user-set ingrowth diameter limit during this cycle). It has nothing at all to do with growth from one of the user-set diameter classes to another. The next line shows that no trees in the 5- to 11-inch class died or were cut so the 240 initial trees plus the 160 ingrowth trees equal the 400 trees currently in this class.

If a tree crosses the ingrowth limit during the period represented but dies or is cut before the current year, it will be tallied in the MORTALITY or the REMOVALS column—not in the INGROWTH column. New trees on the plot (regeneration) are not shown in this example because regeneration did not occur during this cycle. If regeneration had occurred, each new tree would have been tallied in the diameter class appropriate to its diameter in the last year represented by the table. The trees cannot appear in the INITIAL column because they did not exist at the initial time. Note carefully again the definition of ingrowth. A new tree will be tallied in the INGROWTH column only if it crosses the ingrowth limit. If it does not cross the ingrowth limit and lives until the end of the cycle, it will be tallied in the NON-ING and CURRENT columns. If the regeneration tree dies or is cut before the end of the cycle, it is tallied in the MORTALITY or REMOVALS column in the diameter class it occupied at the time it died or was cut.

"STEMS": SAMPLE RUN FOR RELEASE VERSION OF THE TREE GROWTH PROJECTION SYSTEM.
"STEMS": TABL STANDARD OUTPUT SUMMARY PROGRAM.

STEMS 80/07/31.

PROPERTY FREP FOREST PLOT 317 A

PLOT SUMMARY TABLE FOR CYCLE 1 OF 3

COVER TYPE	JACK PINE	PLOT SITE INDEX	60
INITIAL YEAR	1980	CURRENT YEAR	1990
INITIAL AGE	30	CURRENT AGE	40
PROBABILISTIC MORTALITY USED.		AVERAGE STAND DIAMETER (INCHES)	5.6

MEAN ANNUAL INCREMENT 22.5 CUBIC FEET PER ACRE PER YEAR.
MANAGEMENT ACTION IN YEAR 1985: DO NOTHING

PLOT AREA EXPANSION FACTOR 1.
ALL VALUES ARE ON A PER ACRE BASIS.
ALL VOLUMES ARE IN CUBIC FEET.
INGROWTH DIAMETER: TREES AND BA= 5.0 INCHES.
INGROWTH DIAMETER: VOLUMES = 5.0 INCHES.

NUMBER OF TREES AND BASAL AREA INFORMATION.

SPECIES GROUP	DIAMETER CLASS	...INITIAL.. TREES	BA	...NON-ING... TREES	BA	..INGROWTH.. TREES	BA	..MORTALITY. TREES	BA	..REMOVALS.. TREES	BA	...CURRENT.. TREES	BA	GROWTH (BA)
JACK PINE	0.0- 5.0	260.	25.1	60.	7.1	0	0	40.	3.0	0	0	60.	7.1	
	5.0-11.0	240.	41.8	240.	63.6	160.	26.8	0	0	0	0	400.	90.3	
	11.0- +	0	0	0	0	0	0	0	0	0	0	0	0	
	TOTAL	500.	66.9	300.	70.7	160.	26.8	40.	3.0	0	0	460.	97.4	30.5
QUAK.ASPEN	0.0- 5.0	380.	19.7	160.	13.1	0	0	160.	5.7	0	0	160.	13.1	
	5.0-11.0	20.	2.8	20.	4.8	60.	9.8	0	0	0	0	80.	14.5	
	11.0- +	0	0	0	0	0	0	0	0	0	0	0	0	
	TOTAL	400.	22.5	180.	17.9	60.	9.8	160.	5.7	0	0	240.	27.6	5.1
TOTAL	0.0- 5.0	640.	44.8	220.	20.2	0	0	200.	8.7	0	0	220.	20.2	
	5.0-11.0	260.	44.7	260.	68.3	220.	36.5	0	0	0	0	480.	104.8	
	11.0- +	0	0	0	0	0	0	0	0	0	0	0	0	
	TOTAL	900.	89.4	480.	88.5	220.	36.5	200.	8.7	0	0	700.	125.0	35.6

VOLUME BY COMPONENTS OF GROWTH. CUBIC FEET.

SPECIES GROUP	DIAMETER CLASS	INITIAL VOLUME	GROWTH ON NON-ING	INGROWTH	GROWTH ON INGROWTH	OTHER GROWTH	GROSS GROWTH	MORTALITY	NET GROWTH	REMOVALS	NET INC. INVENTORY	CURRENT VOLUME
JACK PINE	0.0- 5.0	0	0	0	0	0	0	0	0	0	0	0
	5.0-11.0	265.3	280.4	113.5	48.8	0	442.6	0	442.6	0	442.6	707.9
	11.0- +	0	0	0	0	0	0	0	0	0	0	0
	TOTAL	265.3	280.4	113.5	48.8	0	442.6	0	442.6	0	442.6	707.9
QUAK.ASPEN	0.0- 5.0	0	0	0	0	0	0	0	0	0	0	0
	5.0-11.0	34.8	32.8	99.2	25.2	0	157.2	0	157.2	0	157.2	192.0
	11.0- +	0	0	0	0	0	0	0	0	0	0	0
	TOTAL	34.8	32.8	99.2	25.2	0	157.2	0	157.2	0	157.2	192.0
TOTAL	0.0- 5.0	0	0	0	0	0	0	0	0	0	0	0
	5.0-11.0	300.1	313.2	212.6	74.0	0	599.8	0	599.8	0	599.8	899.9
	11.0- +	0	0	0	0	0	0	0	0	0	0	0
	TOTAL	300.1	313.2	212.6	74.0	0	599.8	0	599.8	0	599.8	899.9

Figure 4a.—*Example of plot summary table from TABL. The definition for each term used in the heading and in the body of the table are presented in Appendix V.*

"STEMS": SAMPLE RUN FOR RELEASE VERSION OF THE TREE GROWTH PROJECTION SYSTEM.
"STEMS": TABL STANDARD OUTPUT SUMMARY PROGRAM.

PROPERTY FREP FOREST PLOT 317 A

PLOT SUMMARY TABLE FOR CYCLE 2 OF 3

COVER TYPE	JACK PINE	PLOT SITE INDEX	60
INITIAL YEAR	1990	CURRENT YEAR	2000
INITIAL AGE	40	CURRENT AGE	50
PROBABILISTIC MORTALITY USED.		AVERAGE STAND DIAMETER (INCHES)	7.8

MEAN ANNUAL INCREMENT 25.8 CUBIC FEET PER ACRE PER YEAR.
MANAGEMENT ACTION IN YEAR 1995: THIN

PLOT AREA EXPANSION FACTOR 1.
ALL VALUES ARE ON A PER ACRE BASIS.
ALL VOLUMES ARE IN CUBIC FEET.
INGROWTH DIAMETER: TREES AND BA= 5.0 INCHES.
INGROWTH DIAMETER: VOLUMES = 5.0 INCHES.

NUMBER OF TREES AND BASAL AREA INFORMATION.

SPECIES GROUP	DIAMETER CLASS	...INITIAL.. TREES	BA	...NON-ING... TREES	BA	..INGROWTH.. TREES	BA	..MORTALITY. TREES	BA	..REMOVALS.. TREES	BA	...CURRENT.. TREES	BA	GROWTH (BA)
JACK PINE	0.0- 5.0	60.	7.1	0	0	0	0	0	0	20.	2.1	0	0	
	5.0-11.0	400.	90.3	260.	87.5	0	0	80.	17.5	100.	17.0	260.	87.5	
	11.0- +	0	0	0	0	0	0	0	0	0	0	0	0	
	TOTAL	460.	97.4	260.	87.5	0	0	80.	17.5	120.	19.1	260.	87.5	9.2
QUAK.ASPEN	0.0- 5.0	160.	13.1	0	0	0	0	80.	5.8	60.	5.9	0	0	
	5.0-11.0	80.	14.5	0	0	0	0	0	0	100.	20.6	0	0	
	11.0- +	0	0	0	0	0	0	0	0	0	0	0	0	
	TOTAL	240.	27.6	0	0	0	0	80.	5.8	160.	26.5	0	0	-1.1
TOTAL	0.0- 5.0	220.	20.2	0	0	0	0	80.	5.8	80.	8.0	0	0	
	5.0-11.0	480.	104.8	260.	87.5	0	0	80.	17.5	200.	37.6	260.	87.5	
	11.0- +	0	0	0	0	0	0	0	0	0	0	0	0	
	TOTAL	700.	125.0	260.	87.5	0	0	160.	23.2	280.	45.6	260.	87.5	8.1

VOLUME BY COMPONENTS OF GROWTH. CUBIC FEET.

SPECIES GROUP	DIAMETER CLASS	INITIAL VOLUME	GROWTH ON NON-ING	INGROWTH	GROWTH ON INGROWTH	OTHER GROWTH	GROSS GROWTH	MORTALITY	NET GROWTH	REMOVALS	NET INC. INVENTORY	CURRENT VOLUME
JACK PINE	0.0- 5.0	0	0	0	0	0	0	0	0	0	0	0
	5.0-11.0	707.9	345.4	0	0	86.7	432.1	134.1	298.0	104.4	193.6	901.5
	11.0- +	0	0	0	0	0	0	0	0	0	0	0
	TOTAL	707.9	345.4	0	0	86.7	432.1	134.1	298.0	104.4	193.6	901.5
QUAK.ASPEN	0.0- 5.0	0	0	0	0	0	0	0	0	0	0	0
	5.0-11.0	192.0	0	0	0	90.6	90.6	0	90.6	282.5	-192.0	0
	11.0- +	0	0	0	0	0	0	0	0	0	0	0
	TOTAL	192.0	0	0	0	90.6	90.6	0	90.6	282.5	-192.0	0
TOTAL	0.0- 5.0	0	0	0	0	0	0	0	0	0	0	0
	5.0-11.0	899.9	345.4	0	0	177.3	522.7	134.1	388.6	386.9	1.6	901.5
	11.0- +	0	0	0	0	0	0	0	0	0	0	0
	TOTAL	899.9	345.4	0	0	177.3	522.7	134.1	388.6	386.9	1.6	901.5

Figure 4b.—*Example of plot summary table from TABL.*

The third section of the output table presents volumes by the same species group and diameter class breakdowns as above. This section can be omitted if not needed by specifying the units for volumes as 0. Initial volume is the volume at the initial year (1980) for this table. The volumes for this example are in cubic feet and were produced using volume equations supplied by the Resources Evaluation Unit at the North Central Forest Experiment Station. The lower limit for these equations is 5 inches so all volumes in the 0-5 inch class show as zeros. The 200 trees that died during this cycle had no volume according to these equations. Volume information can be developed for each of the available units through repeated runs of TABL.

Of special note is the fact that the ingrowth columns for the volume summary in the third section may not represent the same trees as the ingrowth columns of the upper portion of this table. For this example they are equivalent because both ingrowth diameter limits are equal to the same value (5 inches). However, a user may want to set the ingrowth limit for the trees and basal area table to zero so that all regeneration will show up in the INGROWTH column while leaving the ingrowth limit for volume equal to the lower limit for the volume equations.

Figure 4b represents the second growth cycle for this example plot. A thinning occurred in 1995. The body of the table shows that 120 jack pine trees and 160 quaking aspen trees were cut. In terms of plot basal area, this example stand began with 125.0 square feet in 1990, grew until 1995, was reduced by 45.6 square feet in 1995, grew until the current year, 2000, and completed the cycle with 87.5 square feet. Current (87.5 square feet) plus removals (45.6 square feet) minus initial (125.0 square feet) equals the basal area growth for this plot during this cycle (8.1 square feet). Note that all numbers in this table are subject to round off error.

Appendix V explains the computations used to determine the volume of each of the components of growth. For this example the computations are:

	CUBIC FEET
GROWTH-ON NON-ING	345.4
+	+
INGROWTH	0
+	+
GROWTH ON INGROWTH	0
+	+
GROWTH ON MORTALITY	
+	177.3
GROWTH ON REMOVALS	
=	=
GROSS GROWTH	522.7
–	–
MORTALITY	134.1
=	=
NET GROWTH	388.6
–	–
REMOVALS	386.9
=	=
NET INCREASE IN INVENTORY	1.6
+	+
INITIAL VOLUME	899.9
=	=
CURRENT VOLUME	901.5

The examples shown in figures 4a and 4b are plot summary tables for cycles 1 and 2 for a single plot. After all plots on the input file have been projected, a summary is run for all plots combined and is printed in the same format as the plot summary tables. All column headings have the same meanings but the table entries are scaled differently—the plot summaries are presented on a per acre basis and the run summaries present total values for the area the plots represent. For example, when a survey is made in which each sample plot represents 50 acres of forest, the "plot area expansion factor" will be set at 50 (using variable APRLOC in the user written READ routine). In this case the values in the table will be the total number of trees, total basal area, and total volume on the area surveyed.

Run summaries are printed for each cycle and for all cycles combined. A summary by cover type accompanies each run summary.

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APPENDIX I.

Sample READ Routine for TGPS

This section presents a sample subroutine for reading the initial tree lists that will be projected by TGPS. This subroutine may be used as an example for the subroutine the user must write to read his own data file. This subroutine and sample input file were written by Stephen R. Shifley at the North Central Forest Experiment Station (NCFES). The comments within the FORTRAN source code discuss requirements for the input data and the processing required in the READ routine.

For users who prefer to reformat their data rather than write a new READ routine, the format used in the sample READ routine is presented here. Each plot (each tree list) requires three types of data records: one header record, a tree detail record for each tree, and one trailer record. The header record layout is:

Data	Column	Format
Property	1-16	4A4
Plot name	17-24	2A4
Plot covertype	25-27	I3
Plot site index	28-30	I3
(not used)	31-37	
Year of plot origin	38-42	I5

The tree detail record layout is:

Data	Column	Format
Property name	1-16	4A4
Plot name	17-24	2A4
(not used)	25-27	
Tree Status	28-29	I2
USDA Forest Service species code	30-33	F4.0
Diameter	34-37	F4.1

The Trailer record consists of only one card with a blank in column 1 and the word "END" in columns 2-4.

This READ routine assumes the initial year of projection is 1980 and each sample tree represents 20 trees per acre. The routine is accessed by specifying keyword READ as 2.

```
      SUBROUTINE READ
C
C
C*************************************************************************
C
C     SUBROUTINE "READ" READS AND STORES THE INITIAL PLOT AND TREE
C     INFORMATION UPON WHICH THE PROJECTION OR UPDATE WILL BE
C     BASED.  BECAUSE IT IS ANTICIPATED THAT NO TWO USERS WILL
C     HAVE IDENTICALLY FORMATTED INPUT DATA, THE CREATION OF
C     THE "READ" SUBROUTINE IS GENERALLY LEFT TO THE INDIVIDUAL.
C     IT IS PERMISSIBLE TO INCLUDE ANY VARIETY OF FORTRAN CONTORTIONS
C     IN THE "READ" SUBROUTINE PROVIDED THAT:
C
C       (1)  NO PREVIOUSLY ASSIGNED VARIABLE NAMES ARE USED.
C            (ALL PREVIOUSLY ASSIGNED VARIABLE NAMES ARE LISTED
C            IN THE DATA DICTIONARY WHICH IS SUPPLIED WHEN THE USER
C            REQUESTS A MAGNETIC TAPE COPY OF THE STEMS SYSTEM)
C       (2)  EVENTUALLY THE PROPER AND NECESSARY VALUES FOR THE
C            VARIABLE MEA AND THE ARRAYS TRS, ITRS, IP, IYR, AND BAPY
C            ARRIVE IN THEIR SPECIFIED LOCATIONS.
C
C
C     THE FOLLOWING IS AN EXAMPLE OF A SIMPLE "READ" SUBROUTINE
C     FOR USE WITH A SPECIFIC DATA FILE.  HOPEFULLY, THIS EXAMPLE
C     WILL SERVE AS A GUIDE FOR THOSE WHO WRITE THEIR OWN "READ"
C     SUBROUTINES.
C
C     IN THIS EXAMPLE IT IS ASSUMED THAT THE PLOT AND TREE INFORMATION
C     WILL BE READ FROM A FILE CALLED "TAPE11".  (WITH MINOR MODIFICA-
C     TIONS THIS DATA COULD ALSO BE READ FROM CARD INPUT.)  IT IS FURTHER
C     ASSUMED THAT EACH PLOT RECORD CONSISTS OF A PLOT HEADER
C     CARD IMAGE FOLLOWED BY ONE TREE DETAIL CARD IMAGE FOR EACH TREE
C     ON THE PLOT.  THE END OF EACH PLOT IS DENOTED BY A TRAILER CARD
C     IMAGE WITH " END" IN THE FIRST FOUR COLUMNS.
C
C
C     THE FOLLOWING VARIABLES ARE USED IN THIS EXAMPLE OF "READ":
C
C     APRLOC = AREA IN ACRES REPRESENTED BY THIS PLOT.
C     BAPY(1)= PLOT BASAL AREA PER ACRE.
C     BASUM  = RUNNING TOTAL PLOT BASAL AREA PER ACRE.
C     CR     = TREE CROWN RATIO.
C     DBH    = TREE DIAMETER AT BREAST HEIGHT.
C     I      = TREE COUNTER FOR EACH PLOT AND SERVES TO INDEX
C              TRS AND ITRS ARRAYS.
C     INPLTS = SPECIFIED NUMBER OF PLOTS TO BE READ AS INPUT.
C     ISG    = FREP SPECIES GROUP TO WHICH A TREE BELONGS.
C     ISP(J) = ARRAY, INDEX IS SPECIES CODE, VALUE IS FREP SPECIES GROUP.
```

```
C    ISW1   = SWITCH TO INDICATE END OF A PLOT AND OF ALL PLOTS.
C         ISW1=0 INDICATES LAST PLOT HAS NOT YET BEEN REACHED.
C         ISW1=2 INDICATES LAST PLOT HAS BEEN READ BUT NOT PROCESSED.
C         ISW1=3 INDICATES LAST PLOT HAS BEEN READ AND PROCESSED.
C    IYR(K) = ARRAY HOLDING INITIAL PROJECTION YEAR AND YEAR WHICH
C             ENDS EACH CYCLE.  NOTE THAT ALL YEARS USED IN
C             STEMS MUST BE SPECIFIED IN 4-DIGIT FORM, I.E., 1975 NOT 75.
C    J      = AN INDEX VARIABLE EQUAL TO SPECIES CODE.
C    KPLOT  = PLOT NUMBER OR NAME.
C    KPROP  = PROPERTY NUMBER OR NAME.
C    MEA    = NUMBER OF CYCLES + 1.
C    NORIG  = YEAR OF PLOT ORIGIN.
C    NPLOTS = NUMBER OF PLOTS THAT HAVE BEEN READ FROM DATA FILE.
C    NSITE  = PLOT SITE INDEX.
C    NST    = NUMBER OF TREES (STEMS) IN THE TRS/ITRS ARRAYS.
C    NSTAT  = TREE STATUS CODE.
C    NTYPE  = PLOT COVER TYPE CODE.
C    SPP    = TREE SPECIES CODE.
C    TREEBA = INDIVIDUAL TREE BASAL AREA.
C
C    IP ARRAY:
C      IP(1)  = NUMBER OF TREES IN TRS/ITRS ARRAYS (EQUAL TO NST)
C      IP(5)  = INITIAL PLOT BASAL AREA PER ACRE
C      IP(8)  = PLOT FOREST TYPE
C      IP(9)  = PLOT SITE INDEX
C      IP(10) = PLOT AGE
C      IP(18) = INITIAL YEAR OF PROJECTION/VALIDATION
C
C    ITRS ARRAY WHEN I INDICATES THE ITH TREE ON A PLOT:
C      ITRS(I,1) = TREE STATUS (1=LIVE, 2=CUT, 3=MORTALITY)
C      ITRS(I,7) = TREE CLASS AS NEEDED FOR VOLUME EQUATIONS
C
C    TRS ARRAY WHEN I INDICATES THE ITH TREE ON A PLOT:
C      TRS(I,1)  = TREE SPECIES CODE
C      TRS(I,2)  = TREE DBH
C      TRS(I,3)  = TREE CROWN RATIO
C      TRS(I,5)  = TREE CROWN RATIO CORRECTION FACTOR
C                  (OBSERVED CROWN RATIO - CALCULATED CROWN RATIO)
C      TRS(I,7)  = SET EQUAL TO TRS(I,2), INITIAL TREE DBH
C      TRS(I,13) = TREE EXPANSION FACTOR (TO PER ACRE)
C      TRS(I,16) = BASAL AREA EXPANSION FACTOR (TO PER ACRE)
C
C*******************************************************************
C
      DATA IEND / 4H END /
```

```
C
C*********************************************************************
C     SET 1980 AS THE INITIAL YEAR OF THE PROJECTION.
C     IF DESIRED, THE INITIAL YEAR OF PROJECTION COULD BE READ
C     FOR EACH NEW STEMS RUN, RATHER THAN FIXED AS IT IS HERE.
C*********************************************************************
      DUMMY=0.0
      IYR(1) = 1980
      IP(18) = IYR(1)
C
C*********************************************************************
C     FROM THE PREVIOUSLY READ AND DEFINED "RUN PARAMETERS" IT
C     IS KNOWN THAT NP(3) IS THE NUMBER OF CYCLES AND NP(2) IS
C     THE NUMBER OF YEARS IN EACH CYCLE.  EACH CYCLE MAY BE THOUGHT
C     OF AS A SUMMARY OR MANAGEMENT CYCLE.  MEA IS SET BY
C     DEFINITION TO BE ONE PLUS THE NUMBER OF CYCLES.  THE VALUES IN
C     THE CELLS OF THE ARRAY IYR THAT FOLLOW IYR(1) ARE SEQUENTIALLY
C     SET TO THE YEAR CORRESPONDING TO THE END OF EACH CYCLE.
C
C     NOTE THAT THE ELEMENTS OF IYR() MAY BE ASSIGNED INDIVIDUALLY
C     RATHER THAN IN A LOOP TO ALLOW FOR UNEQUAL LENGTH CYCLES.
C     WHEN THIS PROCESS IS APPLIED, THE USER MUST ENSURE THAT
C     MEA IS SET TO THE NUMBER OF ELEMENTS IN IYR() AND THE
C     NUMBER OF CYCLES IS SET TO MEA - 1.
C*********************************************************************
      MEA = NP(3) + 1
      DO 5 K=2,MEA
    5 IYR(K) = IYR(K-1) + NP(2)
C
C*********************************************************************
C     READ A PLOT HEADER CARD IMAGE AND CHECK TO SEE IF THE
C     END OF THE FILE HAS BEEN REACHED.
C*********************************************************************
   10 READ(11,100,END=38)KPROP,KPLOT,NTYPE,NSITE,NORIG
  100 FORMAT(4A4,2A4,2I3,7X,I5)
      IF(EOF(11).NE.0.0) GO TO 38
C
C*********************************************************************
C     FILL THE APPROPRIATE CELLS IN THE IP ARRAY WITH THE VALUES
C     FOR FOREST TYPE AND SITE INDEX.  IT IS
C     ASSUMED THAT THE FOREST TYPE CODES USED ON THE DATA FILE
C     ARE THE RECOGNIZED STEMS FOREST TYPE CODES.  IF NOT,
C     FOREST TYPE CODES MUST BE CONVERTED TO THOSE RECOGNIZED
C     BY STEMS.  IF SITE INDEX IS NOT INCLUDED ON A PLOT HEADER
C     CARD, IT IS ASSUMED TO BE 70.
C*********************************************************************
      IP(8) = NTYPE
      IP(9) = NSITE
      IF(NSITE.LE.0) IP(9)=70
```

```
C
C*************************************************************************
C    DETERMINE STAND AGE, IP(10), FROM THE DATE OF STAND ORIGIN.
C    NOTE THAT STAND AGE IS NECESSARY ONLY FOR
C    CERTAIN MANAGEMENT ROUTINES IN SUBROUTINE SCREEN.
C*************************************************************************
     IP(10) = IYR(1) - NORIG
C
C*************************************************************************
C    INITIALIZE THE COMBINATION TREE COUNTER AND INDEX VARIABLE, I.
C    INITIALIZE THE BASAL AREA PER ACRE ACCUMULATOR, BASUM.
C*************************************************************************
     I = 1
     BASUM = 0.0
C
C*************************************************************************
C    READ A TREE DETAIL CARD IMAGE AND CHECK FOR THE PLOT
C    TRAILER CARD.
C*************************************************************************
  15 READ(11,200)KPROP,KPLOT,NSTAT,SPP,DBH
 200 FORMAT(4A4,2A4,3X,I2,F4.0,F4.1)
     IF(KPROP(1).EQ.IEND) GO TO 25
C
C*************************************************************************
C    SAVE TREE STATUS IN APPROPRIATE CELL OF ITRS ARRAY.  IT IS
C    ASSUMED THAT THE STATUS CODES PROVIDED WILL BE ONLY THOSE
C    THAT STEMS RECOGNIZES.  WHEN THIS IS NOT THE CASE, FOREIGN
C    STATUS CODES MUST BE CONVERTED TO THOSE USED BY STEMS.
C    ONLY LIVE TREES ARE PROJECTED--OTHERS ARE IGNORED.  IN THIS
C    EXAMPLE, TREES WITH STATUS CODE 4 ARE REASSIGNED A STATUS
C    CODE OF 1 BECAUSE STEMS ONLY RECOGNIZES
C    STATUS CODES 1, 2, AND 3.  THE INPUT DATA SET USES A
C    STATUS CODE OF 4 TO SIGNIFY A NEW TREE ON THE PLOT.
C*************************************************************************
     IF(NSTAT.EQ.1.OR.NSTAT.EQ.4) GO TO 20
     GO TO 15
  20 ITRS(I,1) = NSTAT
     IF(NSTAT.EQ.4) ITRS(I,1)=1
C
C*************************************************************************
C    PLACE THE TREE SPECIES CODE IN THE APPROPRIATE CELL OF THE
C    TRS ARRAY AND ASSIGN A FREP SPECIES GROUP (ISG) BY USING
C    THE CONVERSION ARRAY ISP() THAT WAS SET IN SUBROUTINE
C    SETSYS. NOTE THAT SPECIES CODE IS USED ONLY FOR THIS
C    CONVERSION BUT SPECIES GROUP IS USED THROUGHOUT STEMS
C    FOR PROJECTION AND SUMMARIZATION.  IF THE DATA SET
C    CONTAINS FREP SPECIES GROUPS, THE READ ROUTINE MAY
C    BE ALTERED TO READ ISG DIRECTLY.
C*************************************************************************
     TRS(I,1) = SPP
     ISPG= SPP
     ISG= ISP(ISPG)
     ITRS(I,3)= ISG
```

```
C
C*****************************************************************
C     SAVE DBH AND PLOT EXPANSION FACTOR, CALCULATE BASAL AREA
C     AND THE TREE'S BASAL AREA EXPANSION FACTOR.  ALL PLOTS ARE
C     ONE-SEVENTH ACRE IN THIS EXAMPLE.
C*****************************************************************
      TRS(I,2) = DBH
      TRS(I,7) = DBH
      TREEBA = 0.005454 * (DBH ** 2)
      TRS(I,13) = 7.
      TRS(I,16) = TRS(I,13) * TREEBA
C
C*****************************************************************
C     DETERMINE TREE CLASS TO BE USED IN VOLUME CALCULATIONS.
C     IN ABSENCE OF ANY TREE CLASS INFORMATION, ALL TREES
C     GREATER THAN TWENTY INCHES DBH WILL BE ASSIGNED A TREE
C     CLASS OF 20, AND ALL OTHER TREES WILL BE ASSIGNED A
C     TREE CLASS OF 10. TREE CLASS IS USED ONLY FOR VOLUME COMPUTATIONS.
C*****************************************************************
      ITRS(I,7) = 10
      IF(TRS(I,2).GT.20.0) ITRS(I,7) = 20
C
C*****************************************************************
C     ACCUMULATE BASAL AREA PER ACRE.
C*****************************************************************
      BASUM = BASUM + TRS(I,16)
C
C*****************************************************************
C     INCREMENT TREE COUNTER AND RETURN TO READ THE NEXT TREE
C     RECORD
C*****************************************************************
      I = I + 1
      GO TO 15
C
C
C*****************************************************************
C*****************************************************************
C     END OF A PLOT RECORD.
C     SAVE TOTAL NUMBER OF TREES ON PLOT AS IP(1).
C*****************************************************************
   25 IP(1) = I - 1
      NST = I - 1
C
C*****************************************************************
C     SAVE THE BASAL AREA PER ACRE AS IP(5) AND BAPY(1).
C*****************************************************************
      IP(5) = BASUM
      BAPY(1) = BASUM
```

```
C
C*******************************************************************
C    BECAUSE CROWN RATIO DATA WERE NOT PROVIDED ON TAPE11, THE
C    ESTIMATED CROWN RATIO FOR EACH TREE ON A PLOT WILL BE
C    COMPUTED VIA THE STEMS CROWN RATIO FUNCTION.  THE CROWN
C    RATIO IS COMPUTED BY A CALL TO THE FUNCTION SUBPROGRAM
C    "VALUE".
C*******************************************************************
      DO 30 I=1,NST
      ISG = ITRS(I,3)
      CR = VALUE(1,ISG,TRS(I,2),BASUM,0.0,DUMMY)
      TRS(I,3) = CR
C
C*******************************************************************
C    THE CROWN RATIO CORRECTION FACTOR IS THE DIFFERENCE BETWEEN
C    THE OBSERVED AND PREDICTED CROWN RATIOS.  BECAUSE NO CROWN
C    RATIOS WERE OBSERVED, ALL VALUES OF TRS(I,5) WILL BE
C    SET TO ZERO.
C*******************************************************************
      TRS(I,5) = 0.0
   30 CONTINUE
C
C*******************************************************************
C    SET SWITCH TO INDICATE END OF A PLOT AND CHECK TO SEE IF
C    THE END OF ALL PLOTS HAS BEEN REACHED.
C*******************************************************************
      NPLOTS = NPLOTS + 1
      IF(INPLTS.EQ.NPLOTS.AND.INPLTS.NE.0) GO TO 35
      GO TO 40
C
C*******************************************************************
C    RESET SWITCH TO INDICATE THAT THE LAST PLOT HAS BEEN READ.
C*******************************************************************
   35 ISW1 = 2
      GO TO 40
C
C*******************************************************************
C    RESET SWITCH TO INDICATE THAT THE LAST PLOT HAS BEEN COMPLETED.
C*******************************************************************
C
   38 ISW1= 3
   40 RETURN
      END
```

SAMPLE TREE LIST INPUT FILE
FOR THE EXAMPLE PRESENTED IN
THIS USER'S GUIDE.

```
FREP FOREST     317 A      2 60          1950
FREP FOREST     317 A      1 1 105  30
FREP FOREST     317 A      2 1 105  33
FREP FOREST     317 A      3 1 105  35
FREP FOREST     317 A      4 1 105  43
FREP FOREST     317 A      5 1 105  43
FREP FOREST     317 A      6 1 105  40
FREP FOREST     317 A      7 1 105  41
FREP FOREST     317 A      8 1 105  44
FREP FOREST     317 A      9 1 105  47
FREP FOREST     317 A     10 1 105  48
FREP FOREST     317 A     11 1 105  45
FREP FOREST     317 A     12 1 105  47
FREP FOREST     317 A     13 1 105  46
FREP FOREST     317 A     14 1 105  53
FREP FOREST     317 A     15 1 105  54
FREP FOREST     317 A     16 1 105  52
FREP FOREST     317 A     17 1 105  50
FREP FOREST     317 A     18 1 105  54
FREP FOREST     317 A     19 1 105  50
FREP FOREST     317 A     20 1 105  57
FREP FOREST     317 A     21 1 105  58
FREP FOREST     317 A     22 1 105  60
FREP FOREST     317 A     23 1 105  59
FREP FOREST     317 A     24 1 105  66
FREP FOREST     317 A     25 1 105  63
FREP FOREST     317 A     26 1 741  11
FREP FOREST     317 A     27 1 741  13
FREP FOREST     317 A     28 1 741  13
FREP FOREST     317 A     29 1 741  22
FREP FOREST     317 A     30 1 741  27
FREP FOREST     317 A     31 1 741  26
FREP FOREST     317 A     32 1 741  26
FREP FOREST     317 A     33 1 741  25
FREP FOREST     317 A     34 1 741  28
FREP FOREST     317 A     35 1 741  34
FREP FOREST     317 A     36 1 741  33
FREP FOREST     317 A     37 1 741  34
FREP FOREST     317 A     38 1 741  31
FREP FOREST     317 A     39 1 741  32
FREP FOREST     317 A     40 1 741  38
FREP FOREST     317 A     41 1 741  40
FREP FOREST     317 A     42 1 741  36
FREP FOREST     317 A     43 1 741  43
FREP FOREST     317 A     44 1 741  45
FREP FOREST     317 A     45 1 741  51
 END
COOK COUNTY     BACK 40    2 80 125   0 1947 1970
COOK COUNTY     BACK 40    1 1 105   45 1 0
COOK COUNTY     BACK 40    2 1 105   46 1 0
COOK COUNTY     BACK 40    3 1 105   48 1 0
COOK COUNTY     BACK 40    4 1 105   49 0 0
COOK COUNTY     BACK 40    5 1 105   40 1 0
COOK COUNTY     BACK 40    6 1 105   40 1 0
COOK COUNTY     BACK 40    7 1 105   50 1 0
COOK COUNTY     BACK 40    8 2 105    0 1 0
COOK COUNTY     BACK 40    9 2 105    0 1 0
COOK COUNTY     BACK 40   10 2 105    0 1 0
COOK COUNTY     BACK 40   11 2 105    0 1 0
COOK COUNTY     BACK 40   12 2 105    0 1 0
COOK COUNTY     BACK 40   13 2 105    0 1 0
COOK COUNTY     BACK 40   14 2 105    0 1 0
COOK COUNTY     BACK 40   15 2 105    0 1 0
COOK COUNTY     BACK 40   16 2 105    0 1 0
COOK COUNTY     BACK 40   17 2 105    0 1 0
COOK COUNTY     BACK 40   18 2 105    0 1 0
COOK COUNTY     BACK 40   19 2 105    0 1 0
COOK COUNTY     BACK 40   20 2 105    0 1 0
COOK COUNTY     BACK 40   21 2 105    0 1 0
COOK COUNTY     BACK 40   22 2 105    0 1 0
COOK COUNTY     BACK 40   23 2 105    0 1 0
COOK COUNTY     BACK 40   24 2 105    0 1 0
COOK COUNTY     BACK 40   25 2 105    0 1 0
COOK COUNTY     BACK 40   26 2 105    0 1 0
COOK COUNTY     BACK 40   27 2 105    0 1 0
COOK COUNTY     BACK 40   28 2 105    0 1 0
COOK COUNTY     BACK 40   29 2 105    0 1 0
COOK COUNTY     BACK 40   30 2 105    0 1 0
COOK COUNTY     BACK 40   31 2 105    0 1 0
COOK COUNTY     BACK 40   32 2 105    0 1 0
COOK COUNTY     BACK 40   33 2 105    0 1 0
COOK COUNTY     BACK 40   34 2 105    0 1 0
COOK COUNTY     BACK 40   35 1 105   63 0 0
COOK COUNTY     BACK 40   36 1 125   87 0 0
COOK COUNTY     BACK 40   37 2 105    0 1 0
COOK COUNTY     BACK 40   38 2 105    0 1 0
COOK COUNTY     BACK 40   39 1 125   60 0 3
COOK COUNTY     BACK 40   40 1 125   68 0 0
COOK COUNTY     BACK 40   41 1 105   73 0 0
COOK COUNTY     BACK 40   42 1 105   67 0 0
COOK COUNTY     BACK 40   43 1 125   62 0 3
COOK COUNTY     BACK 40   44 1 125   64 0 2
COOK COUNTY     BACK 40   45 1 105   60 0 0
COOK COUNTY     BACK 40   46 1 125   62 0 0
COOK COUNTY     BACK 40   47 1 105   58 0 0
COOK COUNTY     BACK 40   48 1 105   58 0 0
COOK COUNTY     BACK 40   49 1 105   61 0 0
COOK COUNTY     BACK 40   50 1 125   72 0 2
COOK COUNTY     BACK 40   51 1 105   60 0 0
COOK COUNTY     BACK 40   52 1 125   77 0 3
COOK COUNTY     BACK 40   53 1 105   59 0 0
COOK COUNTY     BACK 40   54 1 105   61 0 0
COOK COUNTY     BACK 40   55 1 105   58 0 0
COOK COUNTY     BACK 40   56 1 125   67 0 0
COOK COUNTY     BACK 40   57 1 105   53 0 0
COOK COUNTY     BACK 40   58 1 125   94 0 2
COOK COUNTY     BACK 40   59 1 105   64 0 0
COOK COUNTY     BACK 40   60 4 125   51 9 3
COOK COUNTY     BACK 40   61 4 105   53 9 0
COOK COUNTY     BACK 40   62 4 125   55 9 0
COOK COUNTY     BACK 40   63 4 105   51 9 0
COOK COUNTY     BACK 40   64 4 105   51 9 0
COOK COUNTY     BACK 40   65 4 105   54 9 0
COOK COUNTY     BACK 40   66 4 125   65 9 2
```

```
COOK COUNTY     BACK 40   67 4 105   51 9 0
COOK COUNTY     BACK 40   68 4 125   65 9 2
COOK COUNTY     BACK 40   69 4 125   60 9 0
COOK COUNTY     BACK 40   70 4 125   64 9 3
COOK COUNTY     BACK 40   71 4 125   57 9 3
COOK COUNTY     BACK 40   72 4 125   51 9 3
COOK COUNTY     BACK 40   73 4 125   51 9 0
COOK COUNTY     BACK 40   74 4 105   52 9 0
COOK COUNTY     BACK 40   75 4 125   54 9 0
 END
BACON COUNTY    LOWER 40  12 52 316   0 1933 1970
BACON COUNTY    LOWER 40   1 3  95    0 2 0
BACON COUNTY    LOWER 40   2 1 746   68 0 4
BACON COUNTY    LOWER 40   3 1  95  106 0 2
BACON COUNTY    LOWER 40   4 3 316    0 2 0
BACON COUNTY    LOWER 40   5 1  95   71 0 2
BACON COUNTY    LOWER 40   6 1  95   69 0 2
BACON COUNTY    LOWER 40   7 1 316   60 0 4
BACON COUNTY    LOWER 40   8 1 746   74 0 3
BACON COUNTY    LOWER 40   9 1  12   53 0 2
BACON COUNTY    LOWER 40  10 1 375   69 0 2
BACON COUNTY    LOWER 40  11 1 316   69 0 2
BACON COUNTY    LOWER 40  12 1 375   61 0 3
BACON COUNTY    LOWER 40  13 1 375   64 0 3
BACON COUNTY    LOWER 40  14 4 375   50 9 2
BACON COUNTY    LOWER 40  15 4 316   56 9 4
BACON COUNTY    LOWER 40  16 4  95   50 9 3
BACON COUNTY    LOWER 40  17 4 375   51 9 2
BACON COUNTY    LOWER 40  18 4 316   50 9 4
BACON COUNTY    LOWER 40  19 4 375   52 9 4
 END
```

APPENDIX II.

Volume and Biomass Equations and Coefficients

The volume equation used for the example in this User's Guide was developed for northeastern Minnesota by the North Central Forest Experiment Station's Resources Evaluation Project (Raile 1981). The equation estimates individual tree volume and has the form:

$$\text{Volume} = b_0 SI(1-e^{-b_1 DBH})^{b_2}$$

where: SI = plot site index (in feet);

DBH = diameter at breast height (in inches); and

b_0, b_1, b_2 are regression coefficients specific to species group, tree class, and the units used for volume.

The biomass equation [1] was also developed for northeastern Minnesota by the Station's Resources Evaluation Project. The equation estimates individual tree biomass in cubic feet and has the form:

$$\text{BIOMASS} = \text{BOBAWT}/\text{BARKWT} + \text{VOLG} + \text{TOPWT}/WT_i$$

where BOBAWT = bole bark weight;

= VOLG X BARKWT X (1.1646 - SCF)

BARKWT = bark weight = 37 pounds/cubic foot;

SCF = species correction factor

$= a_0 + a_1$ DBH;

WT_i = weight factor for species group$_i$;

VOLG = gross bole volume in cubic feet;

$= b_0 SI(1-e^{-b_1 DBH})^{b_2}$

SI = plot site index (in feet);

DBH = diameter at breast height (in inches);

TOPWT = top weight;

= 0.4545 (BOBAWT + VOLG X SCF X WT_i); and

a_0, a_1, b_0, b_1, b_2 are regression coefficients.

The first 62 lines in the coefficient data set show the regression coefficients used for biomass computations. The 63rd line holds a State code which determines which volume equation will be used. The STEMS system at FCCC has equations for Minnesota (discussed above) and for Wisconsin (Hahn 1973). The State codes are 27 and 55 for Minnesota and Wisconsin respectively. The remaining lines hold the regression coefficients for the volume equation.

1	.38799680E+04	.13200139E-02	.23002443E+01	50	MN1 GROSS VOLUME,GREEN WT
2	.17572546E+01	.95480292E-01	.41994575E+01	42	MN1 GROSS VOLUME,GREEN WT
3	.28715330E+10	.44371191E-04	.30966349E+01	36	MN1 GROSS VOLUME,GREEN WT
4	.17447825E+04	.21916846E-02	.24072914E+01	35	MN1 GROSS VOLUME,GREEN WT
5	.24917906E+06	.26315861E-03	.23977579E+01	45	MN1 GROSS VOLUME,GREEN WT
6	.20596682E+07	.20108379E-03	.25821217E+01	32	MN1 GROSS VOLUME,GREEN WT
7	.81119031E+00	.13064328E+00	.39933880E+01	47	MN1 GROSS VOLUME,GREEN WT
8	.36057773E+06	.30379399E-03	.24863319E+01	28	MN1 GROSS VOLUME,GREEN WT
9	.38799680E+04	.13200139E-02	.23002443E+01	43	MN1 GROSS VOLUME,GREEN WT
10	.38799680E+04	.13200139E-02	.23002443E+01	43	MN1 GROSS VOLUME,GREEN WT
11	.30247410E+06	.25658368E-03	.23960683E+01	49	MN1 GROSS VOLUME,GREEN WT
12	.61432027E+04	.10364514E-02	.23009816E+01	40	MN1 GROSS VOLUME,GREEN WT
13	.14251944E+07	.70003432E-04	.22194559E+01	48	MN1 GROSS VOLUME,GREEN WT
14	.14251944E+07	.70003432E-04	.22194559E+01	48	MN1 GROSS VOLUME,GREEN WT
15	.72758341E+05	.51094706E-03	.24996979E+01	54	MN1 GROSS VOLUME,GREEN WT
16	.19035053E+06	.20238435E-03	.22526878E+01	57	MN1 GROSS VOLUME,GREEN WT
17	.18967502E+04	.17450061E-02	.23015127E+01	43	MN1 GROSS VOLUME,GREEN WT
18	.18878049E+06	.20614364E-03	.22729089E+01	56	MN1 GROSS VOLUME,GREEN WT
19	.30247410E+06	.25658368E-03	.23960683E+01	49	MN1 GROSS VOLUME,GREEN WT
20	.61986968E+02	.13001896E-01	.28798039E+01	62	MN1 GROSS VOLUME,GREEN WT
21	.61986968E+02	.13001896E-01	.28798039E+01	62	MN1 GROSS VOLUME,GREEN WT
22	.61986968E+02	.13001896E-01	.28798039E+01	63	MN1 GROSS VOLUME,GREEN WT
23	.61986968E+02	.13001896E-01	.28798039E+01	63	MN1 GROSS VOLUME,GREEN WT
24	.56693257E+06	.30726635E-03	.26014555E+01	43	MN1 GROSS VOLUME,GREEN WT
25	.15095803E+06	.19377755E-03	.21840803E+01	43	MN1 GROSS VOLUME,GREEN WT
26	.22959612E+06	.21939416E-03	.23090850E+01	50	MN1 GROSS VOLUME,GREEN WT
27	.18878049E+06	.20614364E-03	.22729089E+01	52	MN1 GROSS VOLUME,GREEN WT
28	.18878049E+06	.20614364E-03	.22729089E+01	52	MN1 GROSS VOLUME,GREEN WT
29	.18878049E+06	.20614364E-03	.22729089E+01	52	MN1 GROSS VOLUME,GREEN WT
30	.18878049E+06	.20614364E-03	.22729089E+01	50	MN1 GROSS VOLUME,GREEN WT
31	.18878049E+06	.20614364E-03	.22729089E+01	50	MN1 GROSS VOLUME,GREEN WT

1	.8677	.00854	1 MN1 SPECIES CORRECTION FACTORS
2	1.0179	-.00550	2 MN1 SPECIES CORRECTION FACTORS
3	.9588	.00000	3 MN1 SPECIES CORRECTION FACTORS
4	1.0552	.00000	8 MN1 SPECIES CORRECTION FACTORS
5	.9992	.00000	10 MN1 SPECIES CORRECTION FACTORS
6	.9577	.00504	9 MN1 SPECIES CORRECTION FACTORS
7	1.0552	.00000	12 MN1 SPECIES CORRECTION FACTORS
8	1.0343	.00000	15 MN1 SPECIES CORRECTION FACTORS
9	.8468	.00618	11 MN1 SPECIES CORRECTION FACTORS
10	.8677	.00854	17 MN1 SPECIES CORRECTION FACTORS
11	.9844	.00000	30 MN1 SPECIES CORRECTION FACTORS
12	.9739	.00000	33 MN1 SPECIES CORRECTION FACTORS
13	1.0219	.00000	28 MN1 SPECIES CORRECTION FACTORS
14	1.0219	.00000	28 MN1 SPECIES CORRECTION FACTORS
15	.9895	.00000	29 MN1 SPECIES CORRECTION FACTORS
16	1.0241	.00000	26 MN1 SPECIES CORRECTION FACTORS
17	.9707	.00000	24 MN1 SPECIES CORRECTION FACTORS
18	1.0442	-.00164	27 MN1 SPECIES CORRECTION FACTORS
19	.9611	.00000	31 MN1 SPECIES CORRECTION FACTORS
20	.9348	.00000	18 MN1 SPECIES CORRECTION FACTORS
21	.9658	.00191	20 MN1 SPECIES CORRECTION FACTORS
22	.9720	.00000	21 MN1 SPECIES CORRECTION FACTORS
23	.9611	.00000	22 MN1 SPECIES CORRECTION FACTORS

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24       .9151     .00365       37          MN1 SPECIES CORRECTION FACTORS
25       .9151     .00365       38          MN1 SPECIES CORRECTION FACTORS
26       .9821     .00205       39          MN1 SPECIES CORRECTION FACTORS
27      1.0000     .00000       49          MN1 SPECIES CORRECTION FACTORS
28      1.0000     .00000       49          MN1 SPECIES CORRECTION FACTORS
29      1.0000     .00000       49          MN1 SPECIES CORRECTION FACTORS
30      1.0000     .00000       49          MN1 SPECIES CORRECTION FACTORS
31      1.0000     .00000       49          MN1 SPECIES CORRECTION FACTORS
27         USE VOLUME EQUATIONS IN MINNESOTA FORM.  (SURVEY STATE CODE)
MINNESOTA UNIT 1           CUBIC FOOT VOLUME TREE CLASS 10
 5 1 1 1 2 3 2 3 3 1 1 4 5 4 4 4 4 4 4 4 4 4 4 4 4 5 5 4 4 4 4 4 4 MN1  CUFT TC10
MN1 CF10 1 .21540000E+04 .65100000E-02 .35200000E+01
MN1 CF10 2 .64000000E+02 .46000000E-02 .17800000E+01
MN1 CF10 3 .91524279E+00 .24112341E+00 .11451427E+02
MN1 CF10 4 .83000000E+02 .83000000E-02 .24400000E+01
MN1 CF10 5 .41768690E+03 .49219817E-02 .25899789E+01
                     MINN CUBIC FOOT VOLUME TREE CLASS 20
18 3 2 1 4 6 5 7 8 3 3131412121810171113 9 9 9 9151610101010 9 9 MN1  CUFT TC20
MN1 CF20 1 .28972101E+10 .45372009E-04 .31282924E+01
MN1 CF20 2 .16650928E+01 .94595133E-01 .42292999E+01
MN1 CF20 3 .37466374E+04 .13285533E-02 .23137367E+01
MN1 CF20 4 .14214699E+04 .23318005E-02 .23822371E+01
MN1 CF20 5 .20358016E+07 .22634121E-03 .26126824E+01
MN1 CF20 6 .24216650E+06 .26201077E-03 .23979320E+01
MN1 CF20 7 .13038862E+01 .10502908E+00 .40625165E+01                MINN VOL.REG
MN1 CF20 8 .16644100E+01 .90925287E-01 .42919912E+01                MINN VOL.REG
MN1 CF20 9 .62323925E+02 .12621479E-01 .28786215E+01
MN1 CF2010 .18739563E+06 .21350158E-03 .22691608E+01
MN1 CF2011 .13664993E+06 .18888452E-03 .22073354E+01
MN1 CF2012 .79955838E+07 .14119657E-03 .27298454E+01
MN1 CF2013 .31223223E+06 .26318034E-03 .24369796E+01
MN1 CF2014 .56627231E+04 .10196967E-02 .23036378E+01
MN1 CF2015 .53277110E+06 .31430174E-03 .26321600E+01
MN1 CF2016 .16167180E+06 .20104843E-03 .22316894E+01
MN1 CF2017 .17900000E+04 .17000000E-02 .23000000E+01
MN1 CF2018 .69198214E+05 .51802127E-03 .25025657E+01
                     MINN CUBIC FOOT VOLUME TREE CLASS 30
11 1 1 1 2 3 2 4 5 1 1 910 8 811 711 6 9 6 6 6 61010 7 7 7 7 6 6 MN1  CUFT TC30
MN1 CF30 1 .21931159E+04 .13320763E-02 .22335697E+01
MN1 CF30 2 .52886471E+00 .14937753E+00 .46689976E+01
MN1 CF30 3 .67045745E+00 .89172270E-01 .30292410E+01
MN1 CF30 4 .79363099E+00 .97837980E-01 .29612688E+01
MN1 CF30 5 .81753981E+00 .12156620E+00 .52426035E+01
MN1 CF30 6 .92670312E+00 .11818976E+00 .58018115E+01
MN1 CF30 7 .69636778E+00 .13971019E+00 .56760170E+01
MN1 CF30 8 .78310170E+00 .12297015E+00 .57424357E+01
MN1 CF30 9 .16363869E+01 .10524914E+00 .60086471E+01
MN1 CF3010 .64074496E+00 .13404577E+00 .56018300E+01
MN1 CF3011 .61994648E+01 .66717450E-01 .68232202E+01
                     MINN CUBIC FOOT VOLUME TREE CLASS 40
10 1 1 1 1 2 1 2 3 1 1 7 8 6 610 510 4 7 4 4 4 4 8 8 9 9 9 9 4 4 MN1  CUFT TC40
MN1 CF40 1 .30840387E+01 .59396262E-01 .52999359E+01
MN1 CF40 2 .55904404E+00 .10190386E+00 .47594806E+01
MN1 CF40 3 .43863544E+00 .74168358E-01 .35210901E+01
MN1 CF40 4 .24577631E+01 .51382679E-01 .60114210E+01
MN1 CF40 5 .15022714E+00 .10573110E+00 .63126470E+01
MN1 CF40 6 .66596946E+01 .46796129E-01 .56145451E+01
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MN1 CF40 7 .78453306E-01 .19333277E+00 .40374400E+01
MN1 CF40 8 .49619658E+00 .35284779E-01 .17254951E+01
MN1 CF40 9 .16060590E+00 .17045254E+00 .58040220E+01
MN1 CF4010 .14447736E+00 .18230685E+00 .59406608E+01
                    MINN BOARD FOOT VOLUME TREE CLASS 10
 3 1 1 1 1 1 1 1 1 1 1 2 3 2 2 2 2 2 2 2 2 2 2 2 3 3 2 2 2 2 2 2 MN1  BDFT TC10
MN1 BF10 1 .36427960E+06 .87008589E-03 .26070406E+01
MN1 BF10 2 .20458717E+04 .33606172E-02 .22334050E+01
MN1 BF10 3 .20644432E+04 .33729791E-02 .22369948E+01
                    MINN BOARD FOOT VOLUME TREE CLASS 20
14 3 2 1 4 6 5 6 7 3 31011 8 814 913 810 8 8 8 81212 9 9 9 9 8 8 MN1  BDFT TC20
MN1 BF20 1 .88726721E+05 .13006471E-02 .26171044E+01
MN1 BF20 2 .16140745E+05 .54154500E-03 .18000427E+01
MN1 BF20 3 .50184080E+04 .26130193E-02 .23950691E+01
MN1 BF20 4 .23792600E+07 .60450931E-03 .29556387E+01
MN1 BF20 5 .35444785E+07 .68911048E-03 .30314328E+01
MN1 BF20 6 .39887217E+04 .23251087E-02 .22640536E+01
MN1 BF20 7 .38687357E+04 .25149610E-02 .22101820E+01
MN1 BF20 8 .21802550E+05 .37437360E-03 .17986225E+01
MN1 BF20 9 .73284722E+04 .50627685E-03 .16759540E+01
MN1 BF2010 .89076809E+04 .48432326E-03 .16519990E+01
MN1 BF2011 .40588173E+06 .18875960E-03 .20828578E+01
MN1 BF2012 .93223489E+03 .56563295E-02 .24324702E+01
MN1 BF2013 .77913387E+03 .54791695E-02 .23529415E+01
MN1 BF2014 .10066441E+06 .11001271E-02 .26283184E+01
                    MINN BOARD FOOT VOLUME TREE CLASS 31
 4 1 1 1 1 1 1 1 2 1 1 3 4 3 3 3 3 3 3 3 3 3 3 3 4 4 3 3 3 3 3 3 MN1  BDFT TC31
MN1 BF31 1 .55017844E+01 .10167611E+00 .49336766E+01
MN1 BF31 2 .24448081E+01 .62316562E-01 .17087329E+01
MN1 BF31 3 .18463914E+02 .57351004E-01 .50173406E+01
MN1 BF31 4 .29633584E+06 .14492967E-03 .20614655E+01
                MINN CUBIC FOOT VOLUME IN SAWLOG PORTION TREE CLASS 10
 3 1 1 1 1 1 1 1 1 1 1 2 3 2 2 2 2 2 2 2 2 2 2 2 2 3 3 2 2 2 2 2 MN1  CFSL TC10
MN1 CL10 1 .10562000E+05 .14800000E-02 .25260000E+01
MN1 CL10 2 .21998941E+04 .15836863E-02 .23061826E+01
MN1 CL10 3 .30489834E+04 .18488399E-02 .24854923E+01
                MINN CUBIC FOOT VOLUME IN SAWLOG PORTION TREE CLASS 20
14 3 2 1 4 6 5 6 7 3 31011 8 814 913 810 8 8 8 81212 9 9 9 9 8 8 MN1  CFSL TC20
MN1 CL20 1 .34724823E+04 .19132744E-02 .25001269E+01
MN1 CL20 2 .42552718E+04 .27879516E-03 .16634241E+01
MN1 CL20 3 .22750000E+04 .17000000E-02 .23800000E+01
MN1 CL20 4 .16498026E+04 .64100142E-03 .17784872E+01
MN1 CL20 5 .16630000E+04 .14900000E-02 .21350000E+01
MN1 CL20 6 .17555205E+04 .14654734E-02 .22451216E+01
MN1 CL20 7 .15206155E+04 .14063529E-02 .20991661E+01
MN1 CL20 8 .50961639E+04 .14511642E-03 .16002125E+01
MN1 CL20 9 .11868819E+04 .13317865E-03 .13228810E+01
MN1 CL2010 .24572107E+04 .18872370E-03 .14823480E+01
MN1 CL2011 .15842509E+04 .14787729E-03 .14008905E+01
MN1 CL2012 .31853919E+03 .30318397E-02 .21989733E+01
MN1 CL2013 .26289575E+03 .28374129E-02 .20958490E+01
MN1 CL2014 .34348377E+05 .54079890E-03 .24003267E+01
                MINN CUBIC FOOT VOLUME IN SAWLOG PORTION TREE CLASS 31
 4 1 1 1 1 1 1 1 2 1 1 3 4 3 3 3 3 3 3 3 3 3 3 3 4 4 3 3 3 3 3 3 MN1  CFSL TC31
MN1 CL31 1 .61065394E+03 .19432680E-02 .22056695E+01
MN1 CL31 2 .10711490E+03 .14631036E-02 .15869698E+01
MN1 CL31 3 .44558664E+03 .22802744E-02 .22705239E+01
MN1 CL31 4 .57949571E+02 .91595682E-03 .13250221E+01
```

APPENDIX III.

TGPS System Parameters and Specifications

```
**********************************************************************
*                                                                    *
*   LISTING OF SYSTEM PARAMETER INPUT FILE FREP-R9*STEMS.SYSINPFXX   *
*   FOR TGPS. ALL LINES THAT BEGIN WITH AN ASTERISK (*) ARE FOR      *
*   DISCUSSION PURPOSES ONLY AND DO NOT APPEAR IN THE ACTUAL         *
*   DATA FILE.                                                       *
*                                                                    *
**********************************************************************
*
*
*
**********************************************************************
*     SPECIES GROUP CONVERSION SECTION.                              *
**********************************************************************
*
NUMBER SPECIES GROUPS = 31 CODE OTHER SOFTWOODS = 10 CODE OTHER HARDWOODS = 30
NUMBER LAST SOFTWOOD = 299 NUMBER OF LAST HARDWOOD = 999
 105  1            JACK PINE           JACK PINE
 125  2            RED PINE            RED PINE
 129  3            WHITE PINE          WHITE PINE
 012  5            BALSAM FIR          BALSAM FIR
  94  4            WHITE SPRUCE        WH. SPRUCE
  95  6            BLACK SPRUCE        BLK.SPRUCE
  71  7            TAMARACK            TAMARACK
 241  8            NORTH.WHITE CEDAR   N.WH.CEDAR
 261  9            HEMLOCK             HEMLOCK
 130  1            SCOTCH PINE         JACK PINE
 543 11            BLACK ASH           BLK.GR.ASH
 544 11            GREEN ASH           BLK.GR.ASH
 742 12            COTTONWOOD          COTTONWOOD
 317 13            SILVER MAPLE        SIL.MAPLE
 316 14            RED MAPLE           RED MAPLE
 972 15            ELM,AMERICAN        ELM
 974 15            ELM                 ELM
 975 15            ELM,RED             ELM
 977 15            ELM,ROCK            ELM
 371 16            YELLOW BIRCH        YEL.BIRCH
 951 17            BASSWOOD            BASSWOOD
 318 18            SUGAR MAPLE         HARD MAPLE
 314 18            BLACK MAPLE         HARD MAPLE
 541 19            WHITE ASH           WHITE ASH
 802 20            WHITE OAK           WHITE OAK
 804 20                                WHITE OAK
 823 20                                WHITE OAK
 826 20                                WHITE OAK
 832 20                                WHITE OAK
 833 21                                S.RED OAK
 834 21                                S.RED OAK
 806 22                                O.RED OAK
 809 22                                O.RED OAK
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```
 830 22                                  O.RED OAK
 837 22                                  O.RED OAK
 402 23                                  HICKORY
 403 23                                  HICKORY
 405 23                                  HICKORY
 407 23                                  HICKORY
 409 23                                  HICKORY
 743 24              BIGTOOTH ASPEN      B.T.ASPEN
 741 25              BALSAM POPLAR       QUAK.ASPEN
 746 25              QUAKING ASPEN       QUAK.ASPEN
 375 26              PAPER BIRCH         PAP.BIRCH
 999 31                                  NONCOMMER.
*
**************************************************************************
*     CROWN RATIO FUNCTION COEFFICIENTS.                                 *
**************************************************************************
*
CR.PAR  01    .66400E+01    .01350E+00    .32000E+01   -.05180E+00
CR.PAR  02    .53500E+01    .00530E+00    .15280E+01   -.03300E+00
CR.PAR  03    .67900E+01    .00580E+00    .75900E+01   -.01030E+00
CR.PAR  04    .78400E+01    .00570E+00    .12720E+01   -.14200E+00
CR.PAR  05    .56300E+01    .00470E+00    .35230E+01   -.06890E+00
CR.PAR  06    .55400E+01    .00720E+00    .42000E+01   -.05300E+00
CR.PAR  07    .60000E+01    .00530E+00    .43100E+00   -.00120E+00
CR.PAR  08    .57100E+01    .00770E+00    .22900E+01   -.25300E+00
CR.PAR  09    .57100E+01    .00770E+00    .22900E+01   -.25300E+00
CR.PAR  10    .57100E+01    .00770E+00    .22900E+01   -.25300E+00
CR.PAR  11    .45000E+01    .00320E+00    .79500E+01   -.10500E+00
CR.PAR  12    .43500E+01    .00460E+00    .18200E+01   -.27400E+00
CR.PAR  13    .48500E+01    .00500E+00    .98100E+01   -.00990E+00
CR.PAR  14    .43500E+01    .00460E+00    .18200E+01   -.27400E+00
CR.PAR  15    .44000E+01    .00250E+00    .10000E+01   -.09400E+00
CR.PAR  16    .41800E+01    .00250E+00    .14100E+01   -.51200E+00
CR.PAR  17    .44400E+01    .00370E+00    .20900E+01   -.06500E+00
CR.PAR  18    .34000E+01    .00660E+00    .28700E+01   -.43400E+00
CR.PAR  19    .44900E+01    .00290E+00    .12100E+01   -.06500E+00
CR.PAR  20    .58400E+01    .00820E+00    .32600E+01   -.04900E+00
CR.PAR  21    .42000E+01    .00160E+00    .27600E+01   -.02500E+00
CR.PAR  22    .50600E+01    .00330E+00    .17300E+01   -.06100E+00
CR.PAR  23    .62100E+01    .00730E+00    .99900E+01   -.01000E+00
CR.PAR  24    .41100E+01    .00540E+00    .16500E+01   -.11000E+00
CR.PAR  25    .40000E+01    .00240E+00   -.28300E+01    .02100E+00
CR.PAR  26    .50000E+01    .00660E+00    .49200E+01   -.02630E+00
CR.PAR  27    .40000E+01    .00240E+00   -.28300E+01    .02100E+00
CR.PAR  28    .40000E+01    .00240E+00   -.28300E+01    .02100E+00
CR.PAR  29    .40000E+01    .00240E+00   -.28300E+01    .02100E+00
CR.PAR  30    .40000E+01    .00240E+00   -.28300E+01    .02100E+00
CR.PAR  31    .40000E+01    .00240E+00   -.28300E+01    .02100E+00
```

```
*
**********************************************************************
*     COVER TYPE NAMES AND MANAGEMENT GUIDE ASSIGNMENTS.             *
**********************************************************************
*
  01   01 JACK PINE          02   02 RED PINE           03   03 WHITE PINE
  05   11 HEMLOCK            11   04 BALSAM FIR         12   05 BLACK SPRUCE
  14   07 N. WHITE-CEDAR     15   05 TAMARACK          16   04 WHITE SPRUCE
  18   06 MIX. SWAMP CONF.   40   08 OAK-PINE          53   08 W.OAK-R.OAK-HIC.
  54   08 WHITE OAK          55   08 N. RED OAK        71   12 B.ASH-ELM-MAPLE
  73   12 COTTONWOOD         81   11 MAPLE-BEECH-BIR.  91   09 ASPEN
  92   10 PAPER BIRCH        96   14 OTHER SOFTWOODS   97   14 OTHER HARDWOODS
  98   14 NON-COMMERCIAL     99   14 NON-STOCKED       00   14 TYPE MISMATCH
*
**********************************************************************
*     CRITICAL VALUES FOR MANAGEMENT GUIDES.                         *
**********************************************************************
*
JP SCREEN PARA.     .5   400  2000    60    40    70    60   140   120    80
JP SCREEN PARA.  .6667 68.89  1141  40.4
RP SCREEN PARA.     .5   400     2     9    15    20  2000   160   160   140
RP SCREEN PARA.    120   140   180   200    90    .5   120    .5   150 86.40
RP SCREEN PARA.   1328 85.86
WP SCREEN PARA.     .5   400    20    40   120   110   110   110   110    60
WP SCREEN PARA.     70    70    70    70  40.0
SF SCREEN PARA.     .5   400    40    50    35    20    40   100    45    35
SF SCREEN PARA.    140    75   100    65
BS SCREEN PARA.     25 209.0 1837. 10.60  80.-175.4 2.583
SC SCREEN PARA.     25    36   120    50    60    80    90   100    50    60
SC SCREEN PARA.     80    60    60
WC SCREEN PARA.     25    36   120    50    60   150    50    60   130   200
WC SCREEN PARA.    200   150    60   150    60
OK SCREEN PARA.     55    75    60   100    60    80    50    70    .5    .5
OK SCREEN PARA.     .5    10    10    10    16    20    24    10    25    10
OK SCREEN PARA.     25    10    25    15    15    15  58.0
AS SCREEN PARA.     56    70    20    30    45    20    30    55  2000  1000
AS SCREEN PARA.    130    65  5.56   1.4 -.383
PB SCREEN PARA.     .5    50    60    40    50    80    65   120    80    65
NH SCREEN PARA.     .7  1000    80   9.6    20    16    20    70   110    75
NH SCREEN PARA.    160    90    80    80    85   120    70    70    70    15
LH SCREEN PARA.     55    90    90   100   110    85    85    75
US SCREEN PARA.     20    10
```

```
*
**********************************************************************
*     MORTALITY EQUATION ASSIGNMENTS AND COEFFICIENTS.               *
**********************************************************************
*
25 1 2 3 4 5 6 7 8 9 2101111111213141516171819202122232424242425
MORT JP  1 -.0660000E+00  .6879000E+02  .9780000E+00  .0023000E+00  .000000E+00
MORT RP  2  .1084300E+01  .1101200E+02  .5886600E+00  .0002000E+00  .485000E+00
MORT WP  3  .2350700E+01  .3360900E+02  .1008800E+01  .0020100E+00  .000000E+00
MORT WS  4  .2880600E+01  .3077400E+02  .1230900E+01  .0039600E+00  .000000E+00
MORT BF  5  .2697600E+01  .3055000E+02  .8996300E+00  .0040000E+00 -.230690E+00
MORT BS  6  .2877400E+01  .4329500E+03  .1857600E+01  .0023500E+00  .000000E+00
MORT TAM 7  .0246000E+00  .1607000E+03  .1000000E+01  .0210000E+00  .000000E+00
MORT NWC 8  .2877400E+01  .4329500E+03  .1857600E+01  .0023500E+00  .000000E+00
MORT HEM 9  .2910000E+01  .4080000E+03  .1640000E+01  .0015000E+00  .000000E+00
MORT BA 10  .1640000E+01  .9146000E+02  .1000000E+01  .0094000E+00  .000000E+00
MORT RM 11  .3050000E+01  .3825000E+02  .1000000E+01  .0022000E+00  .000000E+00
MORT ELM12  .2450000E+01  .4080000E+02  .1000000E+01  .0042000E+00  .000000E+00
MORT YB 13  .2340000E+01  .1485000E+03  .1400000E+01  .0032000E+00  .000000E+00
MORT BW 14  .2420000E+01  .5604000E+02  .1000000E+01  .0035000E+00  .000000E+00
MORT HM 15  .8150000E+00  .6693700E+02  .1593400E+01  .0043500E+00  .750000E+00
MORT WA 16  .1782100E+01  .2323100E+03  .1726700E+01  .0022200E+00  .000000E+00
MORT WO 17  .3170000E+01  .2356000E+02  .8000000E+00  .0014000E+00  .000000E+00
MORT SR018  .2309200E+01  .6999800E+04  .2661500E+01  .0046800E+00  .000000E+00
MORT OR019  .2309200E+01  .6999800E+04  .2661500E+01  .0046800E+00  .000000E+00
MORT HI 20  .3062600E+01  .6349500E+02  .1049800E+01  .0013400E+00  .000000E+00
MORT BTA21  .8805000E+00  .5659300E+02  .1215400E+01  .0128800E+00  .000000E+00
MORT QA 22 -.5600000E+00  .2530000E+02  .6800000E+00  .0190000E+00  .000000E+00
MORT PB 23  .2160000E+01  .2880000E+02  .1000000E+01  .0000000E+00  .000000E+00
MORT OHD24  .2233900E+01  .2962900E+02  .1342700E+01  .0074800E+00  .000000E+00
MORT NON25  .2380000E+01  .8590000E+02  .1000000E+01  .0169000E+00  .000000E+00
*
**********************************************************************
*     POTENTIAL DIAMETER GROWTH EQUATION ASSIGNMENTS AND COEFFICIENTS. *
**********************************************************************
*
24 1 2 3 4 5 6 7 8 9 1101111111213141516171819202122232424242424 GROW.ASSIGN
GROW JP  1  .1606200E-00 -.9000000E-05  .3624500E+01  .4000000E-04  .100000E+01
GROW RP  2  .9446000E-01 -.1200000E-03  .2059600E+01  .3500000E-03  .242250E+00
GROW WP  3  .2557800E-00 -.8800000E-03  .1726300E+01  .4000000E-04  .100000E+01
GROW WS  4  .1705600E-00 -.1451600E-01  .1066000E+01  .5200000E-03  .272980E+00
GROW BF  5  .1220000E-00 -.8000000E-03  .1989000E+01  .6000000E-04  .100000E+01
GROW BS  6  .1071300E+00 -.1070000E-02  .2001700E+01  .6000000E-04  .911270E+00
GROW  T  7  .1114700E-00 -.1000000E-04  .3068500E+01  .3000000E-04  .100000E+01
GROW WC  8  .1340300E-00 -.1000000E-05  .3688000E+01  .2000000E-04  .100000E+01
GROW HE  9  .1687200E-00 -.3000000E-06  .3573800E+01  .1000000E-04  .100000E+01
GROW BA 10  .5880700E-01 -.6000000E-08  .5055900E+01  .2400000E-03  .315530E-00
GROW RM 11  .1094800E-00 -.4000000E-04  .2222600E+01  .5000000E-03  .662600E-01
GROW ELM12  .2849600E-00 -.1820000E-02  .1529700E+01  .3000000E-04  .100000E+01
GROW YB 13  .1515500E-00 -.3000000E-05  .3310400E+01  .7000000E-04  .573020E+00
GROW BAS14  .2540200E-00 -.4000000E-05  .2939600E+01  .1000000E-04  .100000E+01
```

```
GROW HM 15  .1877200E-00 -.7000000E-05  .2583900E+01  .2800000E-03  .838500E-01
GROW WA 16  .2116700E-00 -.3000000E-05  .3313100E+01  .1000000E-04  .124300E+00
GROW WO 17  .1265400E-00 -.4000000E-05  .2753800E+01  .5000000E-04  .620860E+00
GROW SR018  .1553500E-00 -.1000000E-06  .3536700E+01  .1800000E-03  .259000E-00
GROW OR019  .1735800E-00 -.7000000E-04  .2445100E+01  .3000000E-04  .952220E-00
GROW HI 20  .1647100E-00 -.2161000E-02  .1394900E+01  .4000000E-04  .716280E-00
GROW BTA21  .2349000E-00 -.9420000E-02  .1104100E+01  .3600000E-03  .153860E-00
GROW QA 22  .2164500E-00 -.9100000E-04  .2603000E+01  .4400000E-04  .100000E+01
GROW PB 23  .1097100E-00 -.3200000E-03  .2023600E+01  .3400000E-03  .212880E-00
GROW OH 24  .3751000E-00 -.2479000E-01  .9628800E+00  .4000000E-04  .100000E+01
*
**********************************************************************
*     MODIFIER FUNCTION COEFFICIENTS.                                *
**********************************************************************
*
MOD   1   1.0000E+00   .2250E+03   .5710E+01  -.9260E+00   .3810E+01   .165E+00
MOD   2N  1.0000E+00   .3000E+03   .1350E+01  -.2230E+01   .2640E+01   .000E+00
MOD   3   1.0000E+00   .3000E+03   .1530E+01  -.2130E+01   .5880E+01   .274E+00
MOD   4   1.0000E+00   .3500E+03   .7670E+01  -.9390E+00   .4700E+01   .254E+00
MOD   5   1.0000E+00   .3250E+03   .1650E+01  -.1940E+01   .8950E+01   .589E+00
MOD   6   1.0000E+00   .2750E+03   .2500E+01  -.1600E+01   .8350E+01   .620E+00
MOD   7   1.0000E+00   .2000E+03   .5290E+00  -.2200E+01   .3230E+01   .638E+00
MOD   8    .9000E+00   .3500E+03   .2000E+01  -.1570E+01   .3510E+01   .120E+00
MOD   9   1.0000E+00   .3000E+03   .9320E+00  -.1580E+01   .4780E+01   .690E+00
MOD  10   1.0000E+00   .3000E+03   .1530E+01  -.2130E+01   .5880E+01   .274E+00
MOD  11   1.0000E+00   .2500E+03   .6230E+00  -.3390E+01   .2990E+02   .777E+00
MOD  12   1.0000E+00   .2500E+03   .1430E+01  -.2340E+01   .1280E+02   .610E+00
MOD  13   1.0000E+00   .2500E+03   .1430E+01  -.2340E+01   .1280E+02   .610E+00
MOD  14   1.0000E+00   .2500E+03   .1430E+01  -.2340E+01   .1280E+02   .610E+00
MOD  15   1.2000E+00   .2500E+03   .1050E+02  -.3070E+00   .1980E+01   .247E+00
MOD  16   1.0000E+00   .2500E+03   .7360E+00  -.6790E+01   .5350E+02   .307E+00
MOD  17   1.3000E+00   .2500E+03   .2860E+01  -.1080E+01   .3240E+01   .253E+00
MOD  18   1.0000E+00   .2500E+03   .1000E+01  -.3330E+01   .1040E+02   .315E+00
MOD  19   1.6000E+00   .2500E+03   .1170E+02  -.4500E+00   .2670E+01   .219E+00
MOD  20   1.0000E+00   .2500E+03   .8170E+00  -.3450E+01   .1530E+02   .501E+00
MOD  21   1.0000E+00   .2500E+03   .1530E+01  -.1500E+01   .4600E+01   .520E+00
MOD  22   1.0000E+00   .2500E+03   .1530E+01  -.1500E+01   .4600E+01   .520E+00
MOD  23   1.0000E+00   .2500E+03   .3020E+01  -.1100E+01   .3540E+01   .280E+00
MOD  24   1.0000E+00   .3000E+03   .1080E+01  -.4810E+01   .4410E+02   .245E+00
MOD  25   1.0000E+00   .3000E+03   .1140E+01  -.4660E+01   .5250E+02   .307E+00
MOD  26   1.0000E+00   .3000E+03   .1260E+01  -.2600E+01   .8560E+01   .350E+00
MOD2P27   1.0000E+00   .3500E+03   .2890E+01  -.1300E+01   .3330E+01   .000E+00
MOD  28   1.0000E+00   .2500E+03   .1530E+01  -.1500E+01   .4600E+01   .520E+00
MOD  29   1.0000E+00   .2500E+03   .1530E+01  -.1500E+01   .4600E+01   .520E+00
MOD  30   1.0000E+00   .2500E+03   .1530E+01  -.1500E+01   .4600E+01   .520E+00
MOD  31   1.0000E+00   .2500E+03   .1530E+01  -.1500E+01   .4600E+01   .520E+00
```

```
MOD   1    .4040E+00   .4860E+00   .4950E+04   .4000E+00                .000E+00
MOD   2N   .1070E-02   .4260E+01   .1030E+02   .6000E+00                .000E+00
MOD   3    .2610E-02   .3290E+01   .2410E+02   .4000E+00                .000E+00
MOD   4    .0000E+00   .1000E+01   .1000E+01   .7700E+00                .000E+00
MOD   5    .1290E+00   .2310E+01   .4000E+01   .5000E+00                .000E+00
MOD   6    .3090E+00   .2020E+01   .4350E+01   .3000E+00                .000E+00
MOD   7    .1230E-03   .4460E+01   .1400E+02   .2000E+00                .000E+00
MOD   8    .0000E+00   .1000E+01   .1000E+01   .8700E+00                .000E+00
MOD   9    .4260E-04   .4170E+01   .2490E+02   .3500E+00                .000E+00
MOD  10    .2610E-02   .3290E+01   .2410E+02   .4000E+00                .000E+00
MOD  11    .4590E-02   .3190E+01   .9600E+01   .4000E+00                .000E+00
MOD  12    .2490E-01   .1940E+01   .3520E+02   .5000E+00                .000E+00
MOD  13    .2490E-01   .1940E+01   .3520E+02   .5000E+00                .000E+00
MOD  14    .2490E-01   .1940E+01   .3520E+02   .5000E+00                .000E+00
MOD  15    .2150E-02   .2660E+01   .4170E+02   .3000E+00                .000E+00
MOD  16    .4120E-01   .2360E+01   .1310E+02   .2000E+00                .000E+00
MOD  17    .7250E-02   .2560E+01   .1200E+02   .3000E+00                .000E+00
MOD  18    .3110E-01   .2140E+01   .1620E+02   .4000E+00                .000E+00
MOD  19    .0000E+00   .1000E+01   .1000E+01   .4700E+00                .000E+00
MOD  20    .1430E-02   .3450E+01   .2110E+02   .2000E+00                .000E+00
MOD  21    .2020E-02   .3070E+01   .2110E+02   .5000E+00                .000E+00
MOD  22    .2020E-02   .3070E+01   .2110E+02   .5000E+00                .000E+00
MOD  23    .6230E-02   .2800E+01   .2150E+02   .4000E+00                .000E+00
MOD  24    .9420E-03   .3480E+01   .1940E+02   .6000E+00                .000E+00
MOD  25    .7650E-02   .2890E+01   .2040E+02   .3000E+00                .000E+00
MOD  26    .3530E-03   .4200E+01   .9650E+01   .5000E+00                .000E+00
MOD2P27    .3760E-03   .3560E+01   .2820E+02   .6000E+00                .000E+00
MOD  28    .2020E-02   .3070E+01   .2110E+02   .5000E+00                .000E+00
MOD  29    .2020E-02   .3070E+01   .2110E+02   .5000E+00                .000E+00
MOD  30    .2020E-02   .3070E+01   .2110E+02   .5000E+00                .000E+00
MOD  31    .2020E-02   .3070E+01   .2110E+02   .5000E+00                .000E+00
*
*****************************************************************************
*     MARKING GUIDE FOR MANAGEMENT ROUTINES.                                *
*****************************************************************************
*
JP 1   8100000000000                  0                0                0          0
JP 2   8100000000000   7100000000000                   0                0          0
JP 3   1009900000000   2009901020304  -4009901020304                     0          0
RP 1  -2009901020304   8120000000000                   0                0          0
RP 2  -2009901020304   8120000000000   7100000000000                    0          0
RP 3   7100000000000                  0                0                0          0
RP 4   1009900000000   2009902000000  -4009902000000                     0          0
RP 5   1009900000000   2009902000000  -4009902000000                     0          0
RP 6   1009900000000   2009902000000  -4009902000000                     0          0
WP 1  -2009902030400   8120000000000                   0                0          0
WP 2   5069901242500   1009900000000   2009902030400  -4009902030400              0
WP 3   5069901242500   1009900000000   2009902030400  -4009902030400              0
WP 4   5059905000000   1009900000000   2009902030400  -4009902030400              0
WP 5   5069901242500   1009900000000   2009902030400  -4009902030400              0
```

```
WP 6   1009900000000  6009903000000                0                0                0
SF 1   9009924250000                0                0                0                0
SF 2  -2009904000000  8120000000000                0                0                0
SF 3   1009900000000  3009904000000 -4009904000000                0                0
SF 4   1009900000000  3009904000000 -4009904000000                0                0
SC 1   9069924250000  9059905000000                0                0                0
SC 2   9009915242526  9009911141600                0                0                0
SC 3   1009900000000  6009904060708                0                0                0
SC 4   9059905000000  9009915242526  9009911141600                0                0
SC 5   1009900000000  6009904060708                0                0                0
WC 1   9069924250000  9059905000000                0                0                0
WC 2   1009900000000  2009904060800 -4009904060800                0                0
WC 3   1009900000000  6009904060800                0                0                0
WC 4   9069924250000  9059905000000                0                0                0
WC 5   1009900000000  2009904060800 -4009904060800                0                0
WC 6   1009900000000  6009904060800                0                0                0
OK 1   1009900000000  2009901020300 -4009901020300                0                0
OK 2   1009900000000  2009901020300 -4009901020300                0                0
OK 3   1009900000000  2009901020300 -4009901020300                0                0
OK 4   1009900000000  2009920212223 -4009920212223                0                0
OK 5   1009900000000  2009920212223 -4009920212223                0                0
OK 6   1009900000000  2009920212223 -4009920212223                0                0
OK 7   1009900000000  2009917181900 -4009917181900                0                0
OK 8   1009900000000  2009917181900 -4009917181900                0                0
OK 9   1009900000000  2009917181900 -4009917181900                0                0
AS 1   1009900000000  3009924250000 -4009924250000                0                0
PB 1   1009900000000  2009924252600 -4009924252600                0                0
PB 2   1009900000000  6009926000000                0                0                0
NH 1   8080000000000                0                0                0                0
NH 2   1009900000000  5109915000000 -5009918000000 -2009916171921 -4009916171921
NH 3   1009900000000  5109915000000 -5009918000000 -2009916171921 -4009916171921
NH 4   1009900000000  6009916171921                0                0                0
NH 5   1009900000000  5109915000000 -2009909160000 -4009909160000                0
NH 6   1009900000000  6009909160000                0                0                0
NH 7   1109900000000 -3189916171800 -5229916171800 -2109916171800 -4109916171800
NH 8   1051000000000                0                0                0                0
NH 9   1999900000000                0                0                0                0
NH10   1051000000000 -2051016171800 -4051016171800                0                0
NH11   1109900000000 -3189916171800 -5229916171800 -2109916171800 -4109916171800
NH12   1051000000000 -2051016171800 -4051016171800                0                0
LH 1   1009900000000  5009915000000 -2009911141600 -4009911141600                0
LH 2   1009900000000  5009915000000 -2009911141600 -4009911141600                0
LH 3   1009900000000  5009915000000  6009911141600                0                0
*
*************************************************************************
*     SPECIES SITE INDEX CONVERSION COEFFICIENTS.                       *
*************************************************************************
*
 2 1 23.850 .630 1 2 19.380 .640 3 2 18.840 .680 4 2 26.580 .560 2 3 15.900 .690
 4 3 20.060 .600 2 4-11.8701.170 3 4 -1.3001.030 8 5 24.470 .92011 5 18.690 .810
```

```
 7 6 11.560 .540 6 7  7.480 .950 5 8  4.870 .470 511  7.040 .6501114  5.616 .870
1115 13.004 .8041116 22.082 .5851117 13.427 .7971118  7.706 .8011119  3.969 .981
1122 35.708 .4441411 20.283 .6881415  8.686 .8991416 10.943 .8021417  9.417 .892
1418  3.336 .9301419   .0171.0651422 18.470 .7601424 21.133 .7661425 21.133 .766
1426 21.976 .6751511 11.452 .8141514 19.926 .6281516 11.861 .7461517 14.611 .770
1518 10.609 .7661519  4.696 .9631522 35.862 .4291524  6.5931.0111525 6.5931 .011
1526 14.042 .7841611  1.6281.0491614  7.837 .8761615  1.3711.0501617 11.951 .880
1618  6.787 .8851619  9.273 .9561622 14.390 .8671624 12.670 .9581625 12.670 .958
1626 17.342 .8061711 13.243 .7891714  4.068 .8811715  6.421 .9041716  2.585 .883
1718  6.299 .8321719   .8851.0121724 17.712 .8471725 17.712 .8471726 13.238 .813
1811 20.285 .7431814  9.362 .8511815  8.840 .9251816 10.327 .8251817 15.101 .821
1819 10.572 .9411822 35.432 .4931824 25.430 .7761825 25.430 .7761826 21.018 .726
1911 12.862 .7661914 21.977 .5931915 10.769 .8071916 12.318 .7151917 18.977 .689
1918 11.189 .7281922 27.478 .5661924 23.089 .7671925 23.089 .7671926 21.765 .674
2621 10.430 .7602211 -9.9461.1542214 -1.339 .9512215  7.671 .9032216  3.045 .849
2218   .906 .8852219-22.9331.3622224 13.919 .8832225 13.919 .8832226 23.734 .628
2416 -5.865 .9342417  1.483 .8552418  2.624 .7802419-17.0001.1112422 15.208 .672
2426  5.271 .8492515  5.206 .8162516 -5.865 .9342517  1.483 .8552518  2.624 .780
2519-17.0001.1112522 15.208 .6722526  5.271 .8492614 -3.591 .9992615  5.168 .899
2616  -.765 .9032617  9.115 .8252618  6.306 .8092619 -3.8531.0232126 29.010 .580
2622   .014 .9972624  -.2391.0772625  -.2391.077
99
*
**********************************************************************
*     CRITICAL VALUES FOR REGENERATION ROUTINES.                     *
**********************************************************************
*
JP 1 1 2 1 1 1  4 1000 1.5 0.10
JP 1 2 2 1 1 1  2  800 1.5 0.10
JP 1 3 2 1 1 1  1  900 1.5 0.10
RP 2 1 2 1 1 1  2  800 1.5 0.10
WP 3 1 2 1 1 1  2  800 1.5 0.10
WP 3 2 1 1 1 1  3 1000 1.5 0.10
SF 4 1 1 1 1 2  5  800 2.0 0.15  4  400 1.0 0.05
SF 4 2 2 1 1 1  4 1000 2.0 0.15
SF 4 3 1 1 0 2 25  800 1.8 0.10  5  400 1.0 0.08
SF 4 4 2 1 1 1  4 1000 2.0 0.20
SF 4 5 1 1 0 2 25  800 1.8 0.10  5  400 1.0 0.05
SF 4 6 2 1 1 1  4 1000 1.8 0.15
SF 4 7 2 1 1 1  4 1000 2.0 0.05
BS 5 1 1 1 1 1  6 1000 1.5 0.05
BS 5 2 1 1 0 1  6 1200 2.0 0.15
MC 6 1 1 1 1 5  4  240 1.5 0.15  5  240 1.4 0.05  6  240 1.3 0.05
                7  240 1.2 0.05  8  240 1.1 0.05
NC 7 1 1 0 0 1  8 1000 2.0 0.10
NC 7 2 1 1 1 1  8 1200 2.5 0.15
AS 9 1 2 1 1 1  4 1000 1.5 0.10
AS 9 2 2 1 1 1  2  800 1.5 0.10
AS 9 3 2 1 1 1  1  900 1.5 0.10
AS 9 4 1 1 0 1 25 1200 1.0 0.05
AS 9 5 2 1 1 1  4 1000 1.5 0.10
AS 9 6 2 1 1 1  2  800 1.5 0.10
AS 9 7 2 1 1 1  1  900 1.5 0.10
AS 9 8 2 1 1 1  4 1000 1.5 0.10
AS 9 9 2 1 1 1  2  800 1.5 0.10
AS 910 2 1 1 1  1  900 1.5 0.10
PB10 1 1 1 0 1 26 1000 1.0 0.10
PB10 2 2 1 1 1  2  800 1.8 0.15
PB10 3 2 1 1 1  1  900 1.9 0.19
```

```
*
**********************************************************************
*     HEIGHT FUNCTION COEFFICIENTS. THESE COEFFICIENTS               *
*     WILL BE REPLACED BY ACTUAL DATA DECK WHEN AVAILABLE.           *
**********************************************************************
*
 HTVAL 01 0000000000 0000000000 0000000000 0000000000
 HTVAL 02 0000000000 0000000000 0000000000 0000000000
 HTVAL 03 0000000000 0000000000 0000000000 0000000000
 HTVAL 04 0000000000 0000000000 0000000000 0000000000
 HTVAL 05 0000000000 0000000000 0000000000 0000000000
 HTVAL 06 0000000000 0000000000 0000000000 0000000000
 HTVAL 07 0000000000 0000000000 0000000000 0000000000
 HTVAL 08 0000000000 0000000000 0000000000 0000000000
 HTVAL 09 0000000000 0000000000 0000000000 0000000000
 HTVAL 10 0000000000 0000000000 0000000000 0000000000
 HTVAL 11 0000000000 0000000000 0000000000 0000000000
 HTVAL 12 0000000000 0000000000 0000000000 0000000000
 HTVAL 13 0000000000 0000000000 0000000000 0000000000
 HTVAL 14 0000000000 0000000000 0000000000 0000000000
 HTVAL 15 0000000000 0000000000 0000000000 0000000000
 HTVAL 16 0000000000 0000000000 0000000000 0000000000
 HTVAL 17 0000000000 0000000000 0000000000 0000000000
 HTVAL 18 0000000000 0000000000 0000000000 0000000000
 HTVAL 19 0000000000 0000000000 0000000000 0000000000
 HTVAL 20 0000000000 0000000000 0000000000 0000000000
 HTVAL 21 0000000000 0000000000 0000000000 0000000000
 HTVAL 22 0000000000 0000000000 0000000000 0000000000
 HTVAL 23 0000000000 0000000000 0000000000 0000000000
 HTVAL 24 0000000000 0000000000 0000000000 0000000000
 HTVAL 25 0000000000 0000000000 0000000000 0000000000
 HTVAL 26 0000000000 0000000000 0000000000 0000000000
 HTVAL 27 0000000000 0000000000 0000000000 0000000000
 HTVAL 28 0000000000 0000000000 0000000000 0000000000
 HTVAL 29 0000000000 0000000000 0000000000 0000000000
 HTVAL 30 0000000000 0000000000 0000000000 0000000000
 HTVAL 31 0000000000 0000000000 0000000000 0000000000
```

APPENDIX IV.

Example of Standard Output File

The Standard Output File is the primary output from Program TGPS. It is intended to serve two purposes. The first purpose is to transfer the projected tree lists from TGPS to TABL, the summary program. For users who will always apply Program TABL and never do any further processing, the contents and structure of this file are irrelevant. The second purpose of the Standard Output File is to provide a file of projected tree lists that is easy to use with any user-written summary routine or standard statistical package. All information available about the plot is included so that summaries can be made for requirements not covered by Program TABL.

This appendix presents a portion of the file from which the example tables used in this Guide were produced. The first five lines hold information that remains constant for a plot throughout the projection period.

The first line shows property name, plot name, area expansion factor for the plot, site index, number of years in the projection, type of mortality, number of cycles for the plot, date and time of the run that created this file. The NP array on the second line holds run parameters for the plot. The SITE array on the third and fourth lines holds site index for each of the 31 FREP species groups and the IYR array on the fifth line shows the year associated with each growth cycle.

The sixth and seventh lines present plot information that changes for each cycle. On the sixth line property and plot names are repeated and current year, cycle number, and cover type are shown. The IP array on the seventh line holds other plot information. The next lines hold the actual tree list. The information presented for tree number 1 is USDA Forest Service species code 105 for jack pine, d.b.h. is 3.0, crown ratio is 3.47, height is 0 (not computed), crown ratio difference is 0, current year's growth is 0 (for initial cycle), initial observed d.b.h. is 3.0, tree expansion factor is 20.0, basal area of this tree is 0.98, tree status is 1 (live), tree number is repeated, FREP species group is 1, and tree class is 10. Tree list entries are shown for the 45 sample trees on this plot. This completes the tree list for the initial conditions (ICYCLE = 0). The remaining information is the first part of the tree list for cycle 1 (ICYCLE = 1).

A more detailed discussion of the Standard Output File can be found in the Programmer's Guide.

```
PROP=FREP FOREST      PLOT=317 A    APRLOC=     1.0 SITE=  60 KYRS=  31 KIND= 1 MEA= 4   80/07/31.   16.33.57.
NP=   2  10   3   1   0       0   0       0   2   0
SITE=  60.0  57.8  60.0  60.0  60.0  60.0  60.0  60.0  60.0  60.0  60.0  60.0  60.0  60.0  60.0  60.0
       60.0  60.0  60.0  60.0  60.0  60.0  60.0  60.0  60.0  60.0  60.0  60.0  60.0  60.0  60.0  60.0
 IYR=  1980  1990  2000  2010
PROP=FREP FOREST      PLOT=317 A    KYR= 1980 ICYCLE=  0 KTYPE=  1 MGTYR=   0 ACT=                    NST=   45
IP=   45    0    0    0   89    1    0    2   60   30  900    0   20    0    0    0    0 1980      0    0
```

1	105.	3.000	3.47	0	0	0	3.00	0	0	0	0	0	20.00	0	0	.98	1	1	1	0	0	0	10
2	105.	3.300	3.51	0	0	0	3.30	0	0	0	0	0	20.00	0	0	1.19	1	2	1	0	0	0	10
3	105.	3.500	3.54	0	0	0	3.50	0	0	0	0	0	20.00	0	0	1.34	1	3	1	0	0	0	10
4	105.	4.300	3.65	0	0	0	4.30	0	0	0	0	0	20.00	0	0	2.02	1	4	1	0	0	0	10
5	105.	4.300	3.65	0	0	0	4.30	0	0	0	0	0	20.00	0	0	2.02	1	5	1	0	0	0	10
6	105.	4.000	3.61	0	0	0	4.00	0	0	0	0	0	20.00	0	0	1.75	1	6	1	0	0	0	10
7	105.	4.100	3.62	0	0	0	4.10	0	0	0	0	0	20.00	0	0	1.83	1	7	1	0	0	0	10
8	105.	4.400	3.66	0	0	0	4.40	0	0	0	0	0	20.00	0	0	2.11	1	8	1	0	0	0	10
9	105.	4.700	3.70	0	0	0	4.70	0	0	0	0	0	20.00	0	0	2.41	1	9	1	0	0	0	10
10	105.	4.800	3.71	0	0	0	4.80	0	0	0	0	0	20.00	0	0	2.51	1	10	1	0	0	0	10
11	105.	4.500	3.67	0	0	0	4.50	0	0	0	0	0	20.00	0	0	2.21	1	11	1	0	0	0	10
12	105.	4.700	3.70	0	0	0	4.70	0	0	0	0	0	20.00	0	0	2.41	1	12	1	0	0	0	10
13	105.	4.600	3.69	0	0	0	4.60	0	0	0	0	0	20.00	0	0	2.31	1	13	1	0	0	0	10
14	105.	5.300	3.78	0	0	0	5.30	0	0	0	0	0	20.00	0	0	3.06	1	14	1	0	0	0	10
15	105.	5.400	3.79	0	0	0	5.40	0	0	0	0	0	20.00	0	0	3.18	1	15	1	0	0	0	10
16	105.	5.200	3.76	0	0	0	5.20	0	0	0	0	0	20.00	0	0	2.95	1	16	1	0	0	0	10
17	105.	5.000	3.74	0	0	0	5.00	0	0	0	0	0	20.00	0	0	2.73	1	17	1	0	0	0	10
18	105.	5.400	3.79	0	0	0	5.40	0	0	0	0	0	20.00	0	0	3.18	1	18	1	0	0	0	10
19	105.	5.000	3.74	0	0	0	5.00	0	0	0	0	0	20.00	0	0	2.73	1	19	1	0	0	0	10
20	105.	5.700	3.83	0	0	0	5.70	0	0	0	0	0	20.00	0	0	3.54	1	20	1	0	0	0	10
21	105.	5.800	3.84	0	0	0	5.80	0	0	0	0	0	20.00	0	0	3.67	1	21	1	0	0	0	10
22	105.	6.000	3.86	0	0	0	6.00	0	0	0	0	0	20.00	0	0	3.93	1	22	1	0	0	0	10
23	105.	5.900	3.85	0	0	0	5.90	0	0	0	0	0	20.00	0	0	3.80	1	23	1	0	0	0	10
24	105.	6.600	3.93	0	0	0	6.60	0	0	0	0	0	20.00	0	0	4.75	1	24	1	0	0	0	10
25	105.	6.300	3.90	0	0	0	6.30	0	0	0	0	0	20.00	0	0	4.33	1	25	1	0	0	0	10
26	741.	1.100	3.36	0	0	0	1.10	0	0	0	0	0	20.00	0	0	.13	1	26	25	0	0	0	10
27	741.	1.300	3.37	0	0	0	1.30	0	0	0	0	0	20.00	0	0	.18	1	27	25	0	0	0	10
28	741.	1.300	3.37	0	0	0	1.30	0	0	0	0	0	20.00	0	0	.18	1	28	25	0	0	0	10
29	741.	2.200	3.43	0	0	0	2.20	0	0	0	0	0	20.00	0	0	.53	1	29	25	0	0	0	10
30	741.	2.700	3.46	0	0	0	2.70	0	0	0	0	0	20.00	0	0	.80	1	30	25	0	0	0	10
31	741.	2.600	3.45	0	0	0	2.60	0	0	0	0	0	20.00	0	0	.74	1	31	25	0	0	0	10
32	741.	2.600	3.45	0	0	0	2.60	0	0	0	0	0	20.00	0	0	.74	1	32	25	0	0	0	10
33	741.	2.500	3.45	0	0	0	2.50	0	0	0	0	0	20.00	0	0	.68	1	33	25	0	0	0	10
34	741.	2.800	3.46	0	0	0	2.80	0	0	0	0	0	20.00	0	0	.86	1	34	25	0	0	0	10
35	741.	3.400	3.50	0	0	0	3.40	0	0	0	0	0	20.00	0	0	1.26	1	35	25	0	0	0	10
36	741.	3.300	3.50	0	0	0	3.30	0	0	0	0	0	20.00	0	0	1.19	1	36	25	0	0	0	10
37	741.	3.400	3.50	0	0	0	3.40	0	0	0	0	0	20.00	0	0	1.26	1	37	25	0	0	0	10
38	741.	3.100	3.48	0	0	0	3.10	0	0	0	0	0	20.00	0	0	1.05	1	38	25	0	0	0	10
39	741.	3.200	3.49	0	0	0	3.20	0	0	0	0	0	20.00	0	0	1.12	1	39	25	0	0	0	10
40	741.	3.800	3.53	0	0	0	3.80	0	0	0	0	0	20.00	0	0	1.58	1	40	25	0	0	0	10
41	741.	4.000	3.54	0	0	0	4.00	0	0	0	0	0	20.00	0	0	1.75	1	41	25	0	0	0	10
42	741.	3.600	3.52	0	0	0	3.60	0	0	0	0	0	20.00	0	0	1.41	1	42	25	0	0	0	10
43	741.	4.300	3.56	0	0	0	4.30	0	0	0	0	0	20.00	0	0	2.02	1	43	25	0	0	0	10
44	741.	4.500	3.57	0	0	0	4.50	0	0	0	0	0	20.00	0	0	2.21	1	44	25	0	0	0	10
45	741.	5.100	3.61	0	0	0	5.10	0	0	0	0	0	20.00	0	0	2.84	1	45	25	0	0	0	10

```
PROP=FREP FOREST      PLOT=317 A    KYR= 1990 ICYCLE=  1 KTYPE=  1 MGTYR=1985 ACT=DO NOTHING          NST=   45
IP=   45    0    1    0   89    1    0    2   60   30  900  700   20    0    0    0    0 1980      0    0
```

1	105.	3.517	3.2322.	0	.0404	3.00	0	0	0	0	0	20.00	0	1990.	1.35	3	1	1	0	0	0	10
2	105.	3.903	3.2822.	0	.0476	3.30	0	0	0	0	0	20.00	0	1990.	1.66	3	2	1	0	0	0	10
3	105.	4.163	3.2722.	0	.0528	3.50	0	0	0	0	0	20.00	0	0	1.89	1	3	1	0	0	0	10

APPENDIX V.

Legend for Summary Tables

THREE TYPES OF TABLES ARE PRODUCED BY "STEMS":

1. PLOT SUMMARY TABLES,
   TWO VERSIONS OF PLOT SUMMARIES ARE PRODUCED:
   A. PLOT SUMMARY TABLE FOR ONE CYCLE.
   B. PLOT SUMMARY TABLE FOR TOTAL PROJECTION PERIOD.
2. RUN SUMMARY TABLE FOR ALL PLOTS IN THE RUN FOR EACH CYCLE AND FOR ALL CYCLES IN THE RUN.
3. COVER TYPE SUMMARY TABLE FOR ALL PLOTS IN THE RUN FOR EACH CYCLE AND FOR ALL CYCLES.

DEFINITIONS OF TERMS USED IN TABLES BY ORDER OF THEIR APPEARANCE:

PLOT SUMMARY TABLE:

DATE -
THE FIRST LINE HOLDS THE PROGRAM NAME ("STEMS") AND THE DATE THAT THESE TREE LISTS WERE PROJECTED. NOTE THAT THIS MAY NOT BE THE SAME DATE THAT THE TABLES WERE PRINTED.

TITLE -
THE NEXT LINE IN EACH TABLE IS THE TITLE SET IN PROGRAM TGPS. NEXT IS THE TITLE SET IN THIS SUMMARY RUN. EACH TITLE IS NO MORE THAN 80 CHARACTERS LONG.

PROPERTY -
AN ARBITRARY PROPERTY IDENTIFIER. MAY CONSIST OF UP TO 16 NUMBERS OR LETTERS. USUALLY SET FROM A TREE LIST HEADER CARD.

PLOT -
AN ARBITRARY PLOT IDENTIFIER. MAY CONSIST OF UP TO 8 NUMBERS OR LETTERS. USUALLY SET FROM A TREE LIST HEADER CARD.

TABLE TYPE -
TABLE TYPE, GROWTH CYCLE NUMBER AND TOTAL NUMBER OF CYCLES.

COVER TYPE -
CURRENT PLOT COVER TYPE. SET IN SUBROUTINE COVTYP ACCORDING TO AMOUNT OF BASAL AREA PRESENT IN EACH SPECIES GROUP.

SITE INDEX -
NUMERIC PLOT SITE INDEX.

PLOT AREA EXPANSION FACTOR -
NUMBER OF ACRES REPRESENTED BY THIS PLOT.

INITIAL YEAR -
BEGINNING YEAR OF THE CYCLE.

CURRENT YEAR -
THE TABLE SUMMARIZES THE CONDITION OF THIS PLOT IN THIS YEAR.

INITIAL AGE -
STAND AGE IN YEARS AT INITIAL YEAR.

CURRENT AGE -
STAND AGE AT CURRENT YEAR.

UNITS -
VOLUMES ARE PRESENTED IN THESE UNITS.

TYPE OF MORTALITY -
EITHER DETERMINISTIC OR PROBABILISTIC.

AVERAGE STAND DIAMETER -
ARITHMETIC AVERAGE OF DIAMETERS OF ALL LIVE TREES ON THE PLOT AT THE CURRENT YEAR.

INGROWTH DIAMETER -
TREES THAT CROSS THIS DIAMETER LIMIT ARE INCLUDED IN THE INGROWTH COLUMN OF THE TREES AND BASAL AREA TABLE.

MEAN ANNUAL INCREMENT -
MEAN ANNUAL INCREMENT (MAI) IS THE SUM OF CURRENT VOLUME AND VOLUME OF ALL REMOVALS THAT OCCURED SINCE THE PROJECTION OF THE PLOT BEGAN, DIVIDED BY THE CURRENT STAND AGE. NOTE THAT IF ANY CUTTING WAS DONE BEFORE PROJECTION BEGAN, THIS VALUE WILL NOT REFLECT THE TRUE MAI.

MANAGEMENT ACTION -
TYPE OF TREATMENT PERFORMED DURING THIS CYCLE.

YEAR OF INITIAL REGENERATION -
PRINTED ONLY IF INITIAL REGENERATION HAS OCCURRED. THIS IS THE YEAR THE PREVIOUS STAND WAS REMOVED, NOT THE YEAR THAT NEW TREES SHOWED UP ON THE TREE LIST.

SPECIES GROUP (FOR OUTPUT SUMMARY) -
GENERALLY A SPECIES GROUP CONTAINS ONLY ONE SPECIES. HOWEVER, IF SEVERAL SPECIES HAVE SIMILAR CHARACTERISTICS OR IF DATA ARE LACKING, SPECIES MAY BE GROUPED. FOR EXAMPLE, AMERICAN ELM, SLIPPERY ELM AND ROCK ELM ARE ALL GROUPED AS ELM. THIS GROUPING IS DONE BY THE USER BEFORE RUNNING "STEMS" AND FORMS THE BASIS FOR AN INDEX TO ACCESS THE VOLUME, MORTALITY, AND OTHER COEFFICIENTS USED IN THE PROJECTION EQUATIONS AND MARKING RULES.

DIAMETER CLASS -
CLASS LIMITS ARE SET BY THE USER AND ARE FOR OUTPUT CLASSIFICATION ONLY. THE SMALLEST CLASS IS BOUNDED BELOW BY ZERO AND THE LARGEST IS OPEN ABOVE.

INITIAL TREES -
NUMBER OF LIVE TREES PER ACRE AT THE BEGINNING OF THIS PERIOD.

INITIAL BA -
BASAL AREA PER ACRE OF LIVE TREES IN SQUARE FEET AT THE BEGINNING OF THIS PERIOD.

NON-ING TREES -
NUMBER OF LIVE TREES PER ACRE THAT DID NOT CROSS A USER-SET INGROWTH DIAMETER LIMIT DURING THE CYCLE. (NON-INGROWTH TREES).

NON-ING BA -
BASAL AREA PER ACRE OF NON-INGROWTH TREES IN SQUARE FEET.

INGROWTH TREES -
NUMBER OF LIVE TREES PER ACRE THAT CROSSED THE USER-SET INGROWTH DIAMETER LIMIT (DBHINT) DURING THIS CYCLE.

INGROWTH BA -
BASAL AREA PER ACRE OF INGROWTH TREES IN SQUARE FEET AT THE CURRENT TIME.

MORTALITY TREES -
NUMBER OF TREES PER ACRE THAT WERE ALIVE AT THE BEGINNING OF THIS PERIOD BUT ARE NOW DEAD. (CLASSIFIED BY DIAMETER AT TIME OF DEATH)

MORTALITY BA -
BASAL AREA OF MORTALITY TREES IN SQUARE FEET AT THE TIME OF DEATH.

REMOVALS TREES -
NUMBER OF TREES PER ACRE THAT WERE CUT DURING THIS PERIOD. (CLASSIFIED BY DIAMETER AT TIME OF CUT)

REMOVALS BA -
BASAL AREA PER ACRE OF REMOVALS IN SQUARE FEET AT TIME OF CUT.

CURRENT TREES -
NUMBER OF LIVE TREES PER ACRE AT THE CURRENT YEAR. NOTE THAT THE TOTAL BY SPECIES GROUP EQUALS (INITIAL TREES) + (REGENERATION TREES) - (MORTALITY TREES) - (REMOVALS TREES). EQUALITY MAY NOT APPLY TO A SINGLE DIAMETER CLASS BECAUSE TREES TEND TO MOVE UP INTO HIGHER DIAMETER CLASSES.

CURRENT BA -
BASAL AREA PER ACRE OF LIVE TREES IN SQUARE FEET.

GROWTH (BA) -
NET BASAL AREA GROWTH FOR THIS PERIOD: (CURRENT BA) + (REMOVALS BA) - (INITIAL BA).

INITIAL VOLUME (INVENTORY OF THE STAND) -
CUBIC FOOT VOLUME PER ACRE OF INITIAL TREES AT THE BEGINNING OF THIS PERIOD. INCLUDES ALL LIVE TREES THAT ARE LARGE ENOUGH TO HAVE VOLUME.

GROWTH ON NON-ING -
CUBIC FOOT VOLUME GROWTH ON NON-ING TREES FOR THIS PERIOD. NON-INGROWTH TREES FOR VOLUME COMPUTATIONS ARE TREES THAT DID NOT CROSS THE USER-SET INGROWTH LIMIT (DBHINV).

INGROWTH AND GROWTH ON INGROWTH -
PRESENT CUBIC FOOT VOLUME OF INGROWTH TREES. INGROWTH VOLUME IS THE VOLUME OF A TREE AT THE USER-SET INGROWTH LIMIT (DBHINV). THE VOLUME INCLUDED BETWEEN CURRENT DIAMETER AND DBHINV IS CONSIDERED GROWTH ON INGROWTH.

OTHER GROWTH -
VOLUME OF GROWTH ON MORTALITY PLUS GROWTH ON REMOVALS. GROWTH ON MORTALITY = VOLUME OF THE TREE AT TIME OF DEATH MINUS THE TREE VOLUME AT THE BEGINNING OF THIS PERIOD.

GROWTH ON REMOVALS = VOLUME OF THE TREE AT TIME OF CUT MINUS THE TREE VOLUME AT THE BEGINNING OF THIS PERIOD.

GROSS GROWTH -
SUM OF ALL VOLUME GROWTH ON PLOT FOR THIS PERIOD. COMPUTED AS: (GROWTH ON NON-ING) + (INGROWTH) + (GROWTH ON INGROWTH) + (GROWTH ON MORTALITY) + (GROWTH ON REMOVALS).

MORTALITY -
VOLUME OF ALL MORTALITY TREES AT THE TIME OF DEATH.

NET GROWTH -
COMPUTED AS: (GROSS GROWTH) - (MORTALITY).

REMOVALS -
VOLUME OF ALL TREES CUT DURING THIS PERIOD.

NET INCREASE IN INVENTORY -
TOTAL CHANGE IN INVENTORY OF THE STAND. COMPUTED AS: (NET GROWTH) - (REMOVALS).

CURRENT VOLUME -
VOLUME OF ALL LIVE TREES REMAINING IN THE STAND AFTER GROWTH, MORTALITY, AND REMOVALS FOR THIS CYCLE AND ALL PREVIOUS CYCLES HAVE BEEN APPLIED TO THE INITIAL TREE LIST. THE TOTAL CURRENT VOLUME FOR EACH SPECIES AND FOR THE PLOT EQUALS: (INITIAL VOLUME) + (NET INCREASE IN INVENTORY). HOWEVER THIS RELATION MAY NOT HOLD FOR DIAMETER CLASS TOTALS BECAUSE TREES GROW AND CHANGE DIAMETER CLASS.

RUN SUMMARY TABLE:

RUN SUMMARY TABLES PRESENT THE CONDITION OF ALL PLOTS IN THE RUN AT THE FINAL YEAR OF PROJECTION. THE MEANINGS OF ALL THE COLUMNS ARE THE SAME AS FOR THE PLOT SUMMARY TABLES EXCEPT THAT THE RUN SUMMARY PRESENTS THE TOTAL VALUES FOR EVERY TREE ON EVERY PLOT EXPANDED BY PLOT AREA EXPANSION FACTOR. THESE ARE NOT AVERAGES AND ARE NOT REDUCED TO A PER ACRE BASIS.

COVER TYPE SUMMARY TABLES:

COVER TYPE SUMMARY TABLES PRESENT COVER TYPE SUMMARIES AT THE FINAL YEAR OF PROJECTION. EACH TABLE ENTRY IS THE AVERAGE FOR THAT COVER TYPE WEIGHTED BY THE AREA IN THAT COVER TYPE.

COVER TYPE -
PLOT COVER TYPE SET IN SUBROUTINE COVTYP ACCORDING TO THE AMOUNT OF BASAL AREA PRESENT IN EACH SPECIES. THIS IS THE COVER TYPE OF THE PLOT AT THE FINAL YEAR OF PROJECTION. NOTE THAT IF A PLOT ENTERS "STEMS" AS NORTHERN HARDWOODS AND THROUGH MORTALITY OR MANAGEMENT BECOMES OAK-HICKORY IT WILL NOT CONTRIBUTE TO THE NORTHERN HARDWOOD LINE IN THE COVER TYPE SUMMARY TABLE.

AREA -
TOTAL AREA REPRESENTED BY THE COVER TYPE (NOT AN AVERAGE).

ALL OTHER COLUMNS ARE THE SAME AS FOR THE PLOT SUMMARY TABLES EXCEPT THAT THE COVER TYPE SUMMARY PRESENTS THE AVERAGE PER ACRE VALUES FOR EACH COVER TYPE FOR ALL PLOTS IN THE RUN.

APPENDIX VI.

Procedure for accessing STEMS at the Fort Collins Computer Center (FCCC)

The version of STEMS described in this Guide resides at FCCC. This appendix presents instructions for National Forest System personnel who wish to use the program at FCCC. Three run streams are available for use:

1. FREP-R9*STEMS.PROJ-SUM-FXX — which runs both the projection program (TGPS) and the summary program (TABL);
2. FREP-R9*STEMS.PROJ-FXX — which runs the projection program only;
3. FREP-R9*STEMS.SUM-FXX — which runs the summary program only.

The run stream for both the projection and summary programs is as follows:

```
 1:@MSG,N . RUNSTREAM FOR PROJECTION AND SUMMARY
 2:@DELETE,C STEMOUTXX.
 3:@ASG,UP STEMOUTXX.,F40///512
 4:@ASG, A TREELIST.                          . INITIAL TREE LIST
 5:@TASG,T 20,512                             . TEMPORARY FILE
 6:@TASG,T 21,512                             . TEMPORARY FILE
 8:@BRKPT PRINT$/STEMOUTXX
 9:@USER*JOB. IDENT FRED-STEMS,FOREST$XX
10:@XQT FREP-R9*STEMS. TGPS                   . TGPS PROGRAM.
11:@ADD FREP-R9*STEMS. TGPSRUNFXX             . TGPS RUN OPTIONS
12:@ADD FREP-R9*STEMS. VOLSLS                 . BIOMASS AND VOLUME COEFFICIENTS
13:@ADD FREP-R9*STEMS. SYSINPFXX              . SYSTEM PARAMETERS AND SPECIFICATIONS
14:@ADD,E TREELIST
15:@XQT FREP-R9*STEMS. TABL                   . TABL PROGRAM
16:@ADD FREP-R9*STEMS. TABLRUNFXX             . TABL RUN OPTIONS
17:@ADD FREP-R9*STEMS. VOLSLS                 . BIOMASS AND VOLUME COEFFICIENTS
18:@ADD FREP-R9*STEMS. LEGEND                 . LEGEND FOR TABLE HEADINGS
19:@BRKPT PRINT$
20:@FREE STEMOUTXX
21:@SYM STEMOUTXX.,,FCR072
```

To create a copy of FREP-R9*STEMS.PROG-SUM-FXX specific to your own National Forest (using OTTAWA-07 as an example), type:

```
@ED,I FREP-R9*STEMS.PROJ-SUM-F07
INPUT      (Computer response)
(CR)       (Carriage return)
EDIT       (Computer response)
ADD  FREP-R9*STEMS.PROJ-SUM-FXX     (Add the entire prior run stream)
EOF  FOUND (Computer response)
C  /XX/07/ ALL  (This will change all occurrences of XX to 07)

(Change the file name TREELIST in lines 4 and 14 to your tree list file)

EXIT
```

Before executing the program you must prepare several other files:

FREP-R9*STEMS.TGPSRUNFXX
  TGPS run options (discussed on p. 2);

FREP-R9*STEMS.VOLSLS
  biomass and volume coefficients (discussed on p. 4 and Appendix II);

FREP-R9*STEMS.SYSINPFXX
  system parameters and specifications (discussed on p. 5 and Appendix III); and

FREP-R9*STEMS.TABLRUNFXX
  TABL run options (discussed on p. 10).

Each file should have the XX changed to your forest code (07 for OTTAWA). To execute the program, type:

```
@ADD FREP-R9*STEMS.PROJ-SUM-F07
```

Your output will be printed at the Regional Office in Milwaukee and mailed to you.

Occasionally, you may need to save the intermediate output (Standard Output File). If so, the projection program should be run separately from the summary program. The run stream for the projection program only is:

```
1:@MSG,N . RUNSTREAM FOR PROJECTION ONLY
2:@MSG,N . STANDARD OUTPUT FILE IS PERMANENT
3:@DELETE,C TGPSOUTFXX.
4:@ASG,UP TGPSOUTFXX.
5:@ASG,A TREELIST.
6:@BRKPT PRINT$/TGPSOUTFXX
7:@USER*JOB.IDENT FREP-STEMS,FOREST$XX
8:@XQT FREP-R9*STEMS.TGPS
9:@ADD FREP-R9*STEMS.TGPSRUNFXX
10:@ADD FREP-R9*STEMS.VOLSLS
11:@ADD FREP-R9*STEMS.SYSINPFXX
12:@ADD,E TREELIST.
13:@BRKPT PRINT$
14:@FREE TGPSOUTFXX.
15:@SYM TGPSOUTFXX.,,FCR072
```

To create your own copy use the same procedure as for FREP-R9*STEMS.PROJ-SUM-FXX except replace that file name with FREP-R9*STEMS.PROJ-FXX.

To execute the projection program only, type:

```
@ASG,UP FILEONE.,F40///512
@ASG,UP FILETWO.,F40///512
@USE  21,FILEONE.
@USE  22,FILETWO.
@ADD  FREP-R9*STEMS.PROJ-F07
```

FILEONE and FILETWO are any temporary file names and 07 is again used as an example.

Next, the summary program should be run. Its run stream is:

```
 1:@MSG,N . RUNSTREAM FOR SUMMARY ONLY
 2:@DELETE,C TABLOUTXX.
 3:@ASG,UP TABLOUTXX.
 4:@TASG,T 20,512
 5:@BRKPT PRINT$/TABLOUTXX
 6:@USER*JOB.IDENT FREP-STEMS.FOREST$XX
 7:@XQT FREP-R9*STEMS.TABL
 8:@ADD FREP-R9*STEMS.TABLRUNFXX
 9:@ADD FREP-R9*STEMS.VOLSLS
10:@ADD FREP-R9*STEMS.LEGEND
11:@BRKPT PRINT$
12:@FREE TABLOUTXX
13:@SYM TABLOUTXX.,,FCR072
```

Create your own copy with the previous procedure except replace the file name with FREP-R9*STEMS.SUM-FXX.

To execute the summary program, type:

```
@ASG,A  FILEONE.
@ASG,A  FILETWO.
@USE  21,FILEONE.
@USE  22,FILETWO.
@ADD  FREP-R9*STEMS.SUM-07
```

Your output will be printed at the Regional Office in Milwaukee and mailed to you.

If you wish to keep the Standard Output File for more than 6 days, you must use the @SAVE command for both FILEONE and FILETWO.

The run streams and procedures presented here provide only a simple way to use the STEMS system. If you require more detailed analyses, contact the Timber Management Group in the Milwaukee Regional Office.

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Belcher, David M.

1981. User's guide to STEMS (Stand and Tree Evaluation and Modeling System). U.S. Department of Agriculture Forest Service, General Technical Report NC-70, 49 p. U.S. Department of Agriculture Forest Service, North Central Forest Experiment Station, St. Paul, Minnesota.

Presents the structure of STEMS, a computer program for projecting the growth of individual trees within the Lake States Region, and discusses its input, processing, major subsystems, and output. Includes an example projection.

KEY WORDS: forest growth, simulation, mixed species, distance independent, individual tree, FORTRAN.